

RAILWAY ENGINEERING

AND MAINTENANCE OF WAY.

WITH WHICH IS INCORPORATED
ROADMASTER AND FOREMAN
BRIDGES--BUILDINGS--CONTRACTING--SIGNALING--TRACK
Published by THE RAILWAY LIST COMPANY

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The Fiscal Year

THE recommendation on which the Railway Engineering Association Committee on "Track" laid the most stress in its annual report was a recommendation that a change be made in the fiscal year. The statement was made that investigation so far has disclosed no real reason for the present dates of the fiscal year.

The evil effects of having the fiscal year commence in June was treated for the first time in an editorial in this publication in the June, 1913, issue. Attention was called to the demoralization of forces resulting from the cutting down of forces in construction, as well as in maintenance. There is another point on which nothing seems to have been said, and that is the economical use of appliances. Certain machines, such as those for ballast loading, unloading and spreading can at best be used only a portion of the year, but the overhead capital and depreciation charges continue throughout the year. Whenever the weather is favorable to the use of such appliances, and they are not at work, the value of the machine in operation is lost to the company. This would not hold true, provided the entire amount of work to be done will not require the full capacity of the machine for the full time in which it can be efficiently operated. But there are few railways, under present financial conditions, which can furnish enough equipment to handle the work even if in use during the entire season.

The demand for all sorts of machinery which promotes economy in maintenance work is thus doubled or tripled after the permission is finally given to go ahead with work, which will be some time in the middle of the Summer if held up till the end of the fiscal year. There are two ways in which the work then done with a rush may result in higher cost: (1) The work will be done hurriedly and poor distribution will result in insufficient or too much material unloaded at certain spots; (2) machinery will be overtaxed and possibly ruined; (3) much work will be done by hand labor that would be immeasurably cheaper if done by power.

Poor distribution will result in an extra handling of material, which, as has been pointed out by students of the transportation problem, often costs more than the entire hauling expense. Track men who have had to re-handle poorly distributed rail, ties, ballast, etc., on push cars realize the heavy unnecessary expense attributable to hurried, incorrect material distribution.

Any device which it is necessary to keep in service constantly in spite of defects soon reaches a condition where necessary repairs may almost equal an entire new machine. Whereas, small repairs when needed will many times absolutely preclude extensive repairs being necessary. Some may say that the remedy for this lies in better machinery, but some purchasing departments buy their materials at bargain prices regardless of quality. And in addition absolute perfection in a railway appliance is almost as rare as perfection in the human family.

No progressive railway man will deny that handling ballast, or possibly even rail by hand, is exorbitant if compared with the work done by present types of machinery.

There is considerable damage and loss in tools for extra gangs whenever the latter are laid off. Insufficient care and attention is given the subject, many extra gang men figuring

their tools are good for one season only. This loss can be partly eliminated by education, but in the meantime, if an extra gang is put to work in July and laid off in September, the loss of tools is liable to be pretty nearly equal to the loss if the gang was worked from April to September.

From an Engineering and Track standpoint, all considerations show a necessity for a change in the date of closing the Fiscal Year, and the Accounting and Financial departments have some exceedingly logical arguments to combat if they oppose the present movement.

Convention Report, A. R. E. A.

THOSE WHO have been regularly attending the annual conventions of the American Railway Engineering Association can note a distinct tendency toward a reduction in the discussion of the different committees' subjects, with a much better distribution of the discussion over the entire number of reports submitted. Contrary to the impression which this might carry, this lesser amount of discussion does not show a reduction or lessening of interest in the reports, or in the conventions, but, on the other hand, rather shows a healthy condition in that the reports are better prepared. The statements made and conclusions drawn are, in general, carefully digested, and are the results of a careful investigation into the subjects by a number of men.

In this year's report in particular it is extremely hard to pick out many portions which do not show on analysis that very careful consideration has been given the subject. Many of these reports leave very little room for discussion, containing as they do the entire results it was possible for the committee to obtain.

The tendency is to give only reports on those subjects on which a great deal of information has been obtained, and in case complete information is not obtained on certain sub-topics, they are generally held over till sufficient data are obtained.

The distribution of the discussion over nearly all of the reports shows a careful reading by the membership of the entire matter, and that nearly every member is cognizant of what is contained in each report.

Condensing or abstracting a report of a meeting, such as the one this year, is very difficult, as in most cases the matter has been very carefully prepared and the statements made as short and concise as possible before publication in the Association bulletins. The report on another page of this issue is not intended to give a verbatim account of the convention, but it is intended to give a concise résumé of the different subjects treated. The results attained, the conclusions drawn, and the justification for the conclusions are given. Readers who are interested particularly in special parts will doubtless wish to receive the bulletins containing the complete report, and these may be obtained by writing the Secretary, Mr. E. H. Fritch, 900 South Michigan avenue, Chicago, Ill.

In general the condensed report given in this issue will be sufficient for those desiring a general knowledge of the conclusions which enable the Association to make an advance in its recommended practice.

The Association is to be highly commended for the quality of the work now being done by the committees. While there has been no reduction in quantity of printed matter, the amount of

information has been greatly increased with practically or comparatively little increase in volume. This comes as a result of more intensive application to the work of compiling the reports, and of then cutting the statements down to the smallest possible volume without sacrificing clearness. Such work is bound to result in benefit to the railways and to the employees of Railway Engineering and Maintenance Departments, and in fact to the benefit of all other railway employees and the traveling public, due to better and safer designs.

Concrete Posts for Right-of-Way Fencing

IT developed, during the discussion on the subject of concrete fence posts, at the convention of the American Railway Engineering Association, that only two railroads have standardized the concrete post for right of way fencing, the fact did not develop that many of the railways have concrete fence posts in service which thus far have appeared perfectly satisfactory. It appears that the hesitation evidenced by those who have been taking part in the discussions concerning the use of concrete posts, is due to their unfamiliarity with them and their doubt as to their proper design. Various shapes have been advocated, as have various types of reinforcement. In general three shapes have been used, and the argument for any shape other than that approaching a square in cross section is, of course, economy in the use of material. It must be taken into consideration, however, that the shape carefully figured out for the use of a minimum amount of material calls for the most careful mixing of concrete as, unless the structure is absolutely homogenous in nature, disastrous weakness is the inevitable result, whereas the post of the approximately square cross section while admittedly not scientifically designed with the view of saving material, can be manufactured on the job and with common labor with less danger of weakening, on account of the greater mass.

It would seem for several reasons that the careful design so necessary in the economical construction of large structures can be carried too far in the case of the concrete post. Other than the reasons mentioned above it must be considered that material is cheapened in a cross section which calls for greater amounts of gravel and cement, as the variations in the richness of the mixture are less dangerous to the completed structure.

The average post of square construction can be built at a cost of approximately twenty cents each. This covers the cost of four No. 5 wire rod reinforcements weighing three pounds; a one to four mixture of cement and gravel; and labor averaging from three to five cents each. The machinery for the manufacture of posts is light and can be moved from point to point with facility. It would appear therefore that the production of concrete posts is as economical in first cost as the purchase of wooden posts.

It is taken for granted that wire fencing is not objectionable, and the fastening of the wire to the post has been practically and successfully worked out as exemplified by many simple and inexpensive devices. It is not contended that there is no chance for improvement in the design of concrete posts, but it is believed that too much attention to the subject of detailed designs will unnecessarily retard the adoption of a material for permanent fencing which in its present stage is already a great improvement over wood.—L. F. W.

Panama Station, Panama R. R.

The new Panama station of the Panama R. R. has been completed. Aside from the interest which is attached to it on account of its location in the canal zone, and the fact that it was built by the U. S. Government, the entire design and type of construction is entirely out of the ordinary. The station building is T-shaped, the leg of the T containing the baggage room, while the remainder of the building is given over to waiting rooms, ticket offices, and other conveniences commonly provided for the public. Due to the segregation of first and second-class passengers the station building has two main entrances, on opposite sides.

The end of the leg of the T is located at the tracks, and the waiting rooms are thus at a considerable distance from the tracks, and are at a higher elevation. Two inclined, covered ramps are provided for passengers, leading to the train sheds. A depressed road, as shown on the plan, was provided to take care of the baggage. This road passes under the ramps and

tween the two ends of about eight feet the floor of the ramp has a 7 per cent grade.

The ironwork in the old station was utilized as far as possible in the baggage room, which made a difference in the appearance of the roofs, that on the baggage department being hip-shaped, and on the main building flat. The floor of the waiting room section is on a level with the street, but the ground floor of the baggage room is on a level with the tracks, a difference of about eight feet. The main section has only two floors, while the baggage room virtually has three, including a mezzanine. The lower floor of the baggage room is used solely for the handling of baggage and express matter.

A 20-ft. sidewalk is provided in the front of the station, and Central avenue was widened from 30 to 50 ft. in front of the building.

An iron fence separates the grounds from the alighting platform, and in this fence there are ten gates, or passenger exits,



Front View, Panama Station, Panama R. R.

enters the baggage room at the back. The floor of the baggage room slopes off slightly and is about 4 ft. above the roadway, providing for economical handling of baggage to and from wagons.

The former station was an old building with a line of iron columns down the middle and built up columns along the walls. These supported the second floor framing, composed of latticed girders and floor beams. The ceiling of the second floor was hung from steel roof trusses, which in turn were carried by built-up columns. Galvanized corrugated iron sheets formed the roof and siding of the building.

The main part of the new building is of the Renaissance style of architecture, has a frontage on Central avenue of 170 feet, and extends back from it a distance of 55 feet. In front of the building there is a row of columns, six in number, made of concrete, each 27 feet high and 3 ft. 4 in. in diameter. On each side of the station there is a vestibule, 20 feet in width, reaching to the roof, with vaulted ceiling. Each vestibule opens on a waiting room, one for the first class and the other for the second class passengers. On each side of the depot, adjoining the vestibules, is a covered porte-cochère, where coaches may come up and discharge passengers. In getting to the trains the passengers pass through a gate to a ramp, or covered way, which extends from the waiting rooms to the train shed. As there is a difference in elevation be-

five for the first-class and an equal number for the second-class passengers. The alighting platform is 30 ft. wide and 800 ft. long, and the train shed is about the same length, with a butterfly-shaped roof. The roof, when completed, will project about 13 ft. over the road. The courts, four in number, will be planted to grass, and later embellished with plants and flowers.

Requirements to Be Met in the Design.

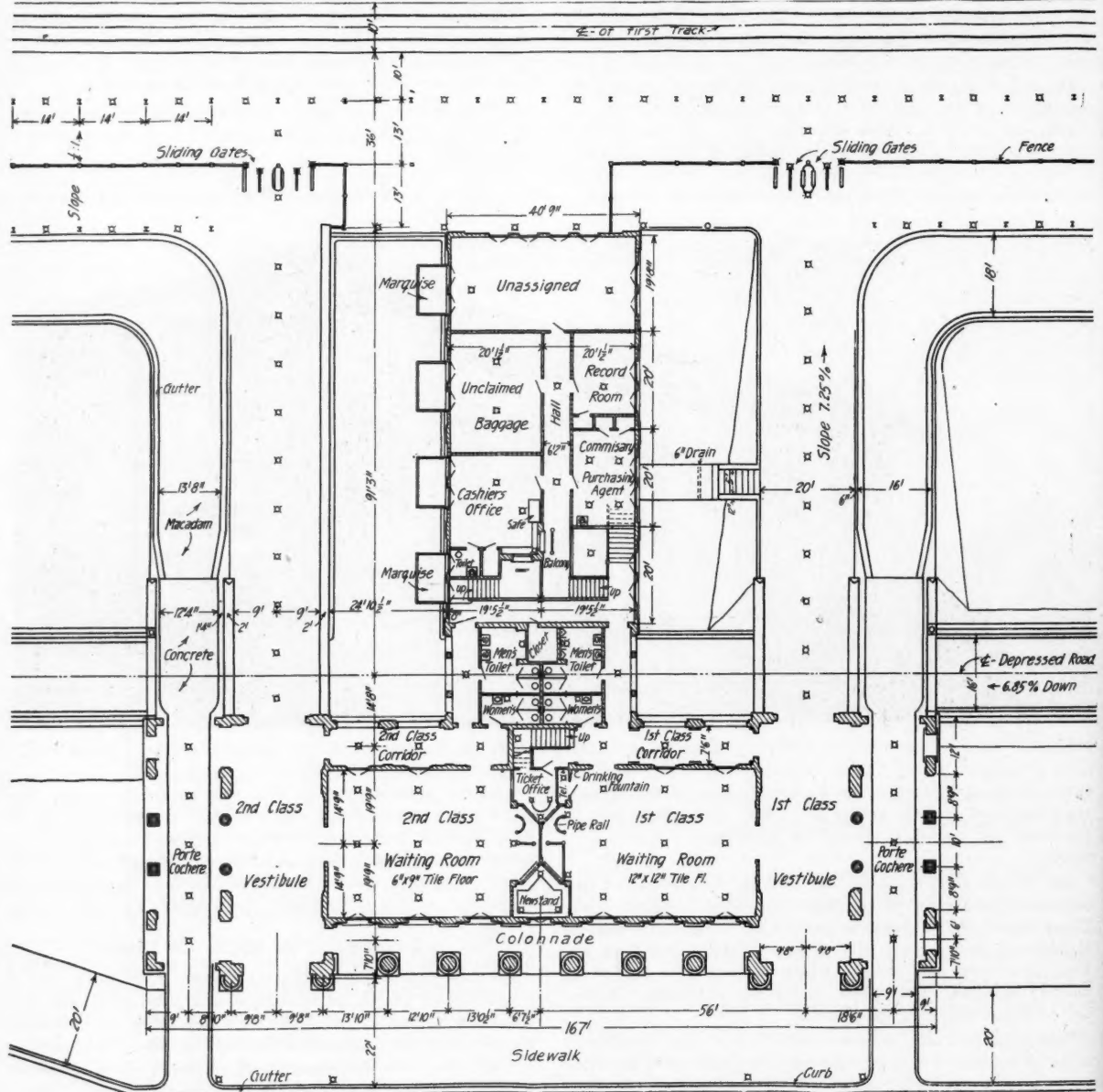
The new station differs in many respects from those erected in the United States, where all patrons travel first class, and also from the continental stations, where there are provisions for two or more classes of travelers. In both cases there is a single main entrance, or group of entrances. In Panama, on the other hand, it is desirable to separate the colored laborers, East Indian coolies, etc., who travel second class, as completely as possible from the white patrons who travel first class. For this reason separate entrances are provided at opposite ends of the building. A large proportion of the first-class passengers use mileages, or some form of pass, so that one man readily handles the ticket selling. Provision is made, however, for dividing the work in case of a rush, between two men, one selling first class and the other second class tickets.

The second-class passengers have little besides hand baggage. For this reason no independent communication with the baggage room was provided for them.

The aim of the layout of the grounds was to keep all traffic moving in the same direction. The baggage wagons enter the depressed road from the south, whether empty or loaded, and leave by the north end. The "coaches," when bringing passengers to a departing train, may deposit them under the porte cochère or continue down the ramp and draw up alongside the alighting platform. The roof of the platform projects 13 ft. over this road, so that passengers even during the tropical downpours of the rainy season, will be protected from the wet. Coaches awaiting the arrival of an incoming train line up

end of the train, baggage cars in the middle and second-class coaches at the north end. Hospital cars and the observation car are attached to the tail end of a train.

The placing of the baggage car in the middle of the train determined the position of the baggage room wing. The floor of the baggage room is on the same level as the alighting platform, to permit the motor trucks to handle the trunks quickly and conveniently, while the north court and depressed road are 4 ft. lower than the baggage room, to facilitate the



First Floor Plan, Panama Station.

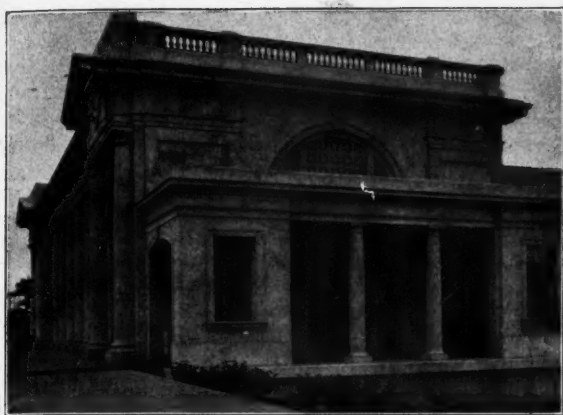
along the curb of the alighting platform. The Canal Zone and Republic of Panama mail wagons drive into the north court and back up against the alighting platform. The Ancon hospital ambulance or coaches awaiting the passengers of the observation car occupy the turn around at the north end of the grounds near the yard office.

To segregate the two classes of passengers, the trains are made up as follows, irrespective of the direction in which the train is to travel: first-class passenger coaches on the south

rapid handling of trunks on or off the wagons. The waiting room floor is 7 ft. above the alighting platform.

The Panama R. R. provides quarters for its employees gratis. Previously barrack-like structures entirely of wood have served the purpose, but in the new station the rooms will have tile floors, Keene's cement base and trim and plaster walls, painted.

Very few offices are required in the new building as the general offices of the railroad are now located in Colon, only fifty miles away.



One of the Two Main Entrances.

Station Building.

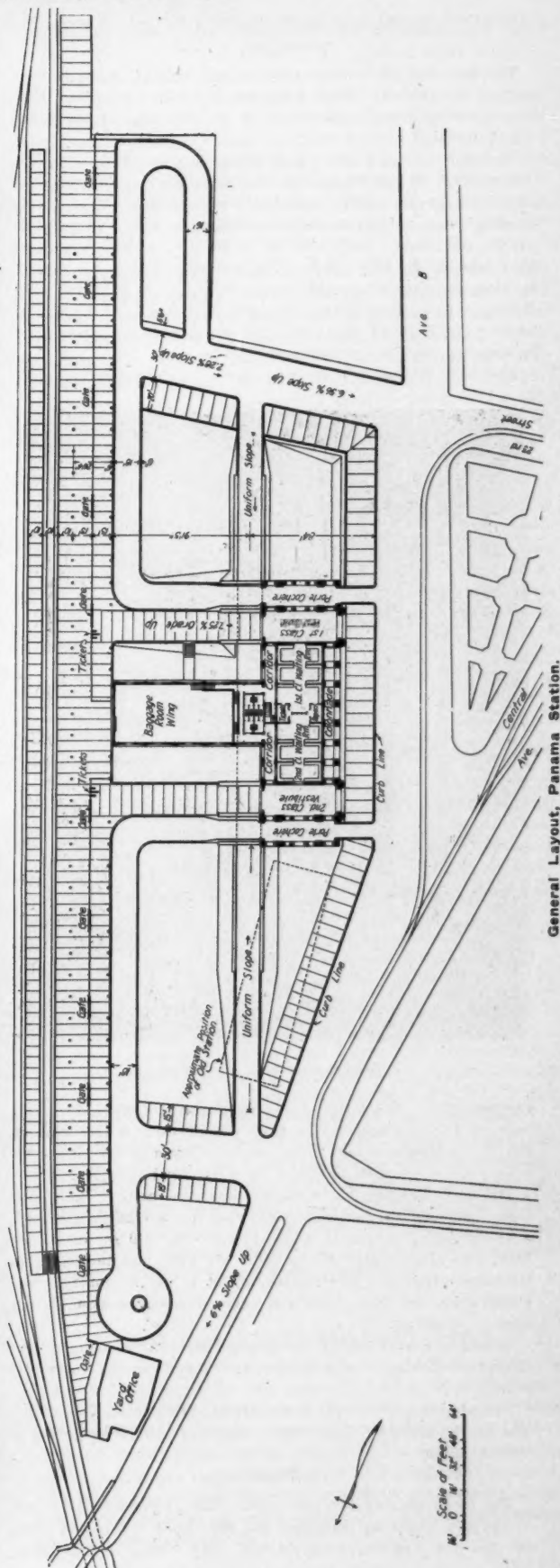
While stucco has been used extensively in residence construction on wooden framework, this is the first railway station of any size built of stucco. The exterior walls are built entirely of stucco on terra cotta blocks, and the building is fireproof with the exception of the door and window sashes. The interior walls are terra cotta blocks with wall plaster.

The free standing columns are of wrought iron pipe, filled with concrete. Columns in walls are reinforced concrete, formed either by filling in the voids of the terra cotta blocks, or by filling the space between the inner and outer terra cotta shell.

The structure rests on a continuous concrete wall, except under columns, where concrete grillages were provided, reinforced with second-hand 70-lb. rails. The unit pressure allowed on the soil was 1,250 lbs. per square foot. The foot-



View Back of Ornamental Columns, Front of Building.



General Layout, Panama Station.

ings were made of 1 to 5 concrete, using Atlas cement and Chagres river gravel.

The first floor of the main station and floor of baggage room rest on the ground. These floors are 6x6 hard burned red tile, waterproofing being unnecessary, as the elevation of the floors was quite high.

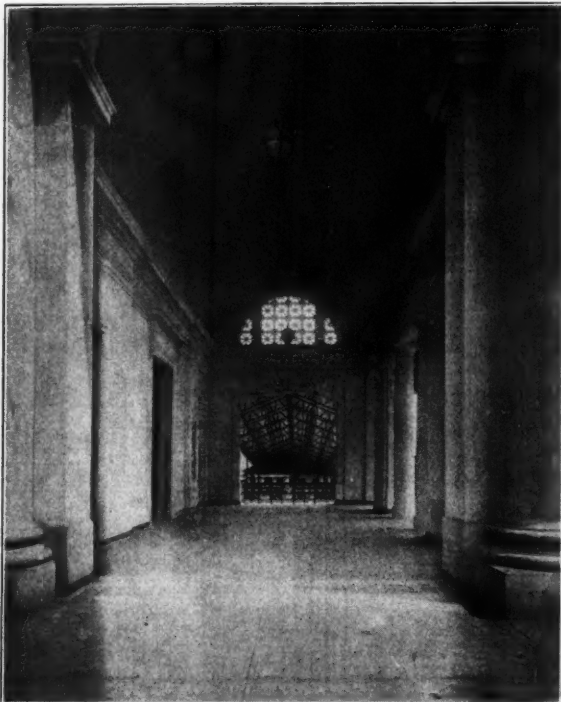
The two waiting rooms are of the same size, but are finished differently. The first-class waiting room has ornamental panelled ceilings and walls, with 12x12-in. tile floor; the second-class waiting room has plain plaster walls and ceilings with 6x9-in. tile floors. Each room is 29 ft. 6 in. wide, 38 ft. 8 in. long, and 18 ft. 4 in. high. The windows, which are spaced as close together as possible, are 4 ft. 6 in. x 10 ft. 3 in., each having a pair of casements swinging in below, and a transom above. In front of the building the windows are necessarily located between the ornamental columns.

The floor of the main waiting room is red burned tile on a

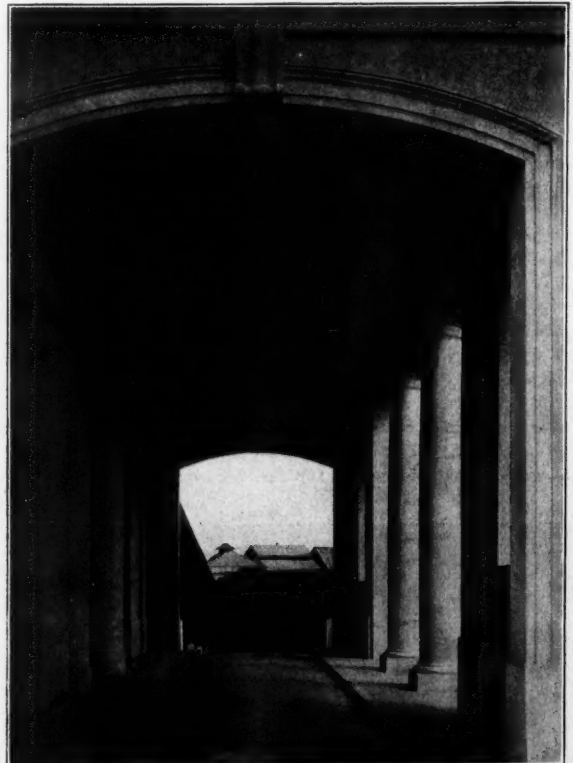
layout consisted merely in increasing the radius of the curve on the south side of the Caledonia bridge and extending a tangent parallel to the platform. The rails are 90 lbs. steel with 100 per cent joints.

Construction.

The footings, foundation walls and piers of the main building and the baggage room wing were built by the Panama R. R. and carried up as nearly to the underside of the respective floor slabs as conditions permitted. The alighting platform, its curb, gutter, roof, roof drainage system, division fence and gates, were also almost entirely completed by the railway. The yard drain was extended underneath the baggage room and a 17-in. concrete drain, circular in section, was placed along the curb of the alighting platform; a sim-



Corridor Leading to Ramp.



Port Cochere.

concrete slab. The latter is 6½ in. thick, reinforced by ½-in. bars on 8-in. centers, having been designed for a live load of 125 lbs. per square foot. The second story floor is also a reinforced concrete slab, designed for a live load of 75 lbs.

The main building has a Barret Specification roof, on a concrete slab, and the baggage room wing has a cement tile roof.

The building covers an area of 12,350 sq. ft., is two stories high, covering nearly all of the old site and considerable territory adjacent. The station layout is of the through terminal type, the train shed and covered passages covering an area of 36,000 sq. ft.

As shown on the layout, the original street was changed considerably, making it straighter, and the depressed road was added.

The alighting platforms are concrete slabs, 36 ft. 6 in. wide, laid on the ground. They were roughened by finishing with a spiked roller.

Track.

The track serving the old station was abandoned, and half of the new alighting platforms and roof built before the plans for the new building were started. The change in the track

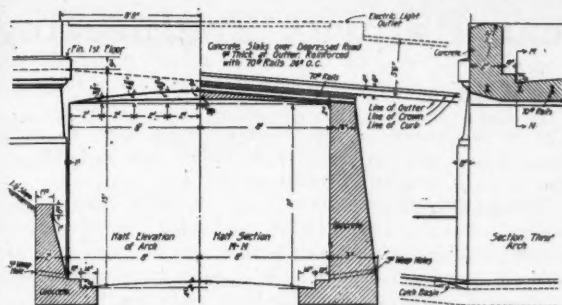
ilar drain was carried beneath the future floor of the main building and connected with the yard drain.

The contractor started in work after the completion of the preliminary work mentioned, and was required to erect the main building portion of the new station (excluding the baggage room).

After the main building had been completed, inspected and accepted by the company the contractor took down the old station and grubbed up its foundations.

Such of this second-hand material as could not be utilized on the site was turned over to the company. The remainder, e. g., the second story window sashes and frames, a few second story doors, the cast-iron columns, built up columns, girders, beams and roof framing, such as was declared in sound condition by the chief engineer, was used in the baggage room wing. The contractor then proceeded to complete the baggage room wing, including finishing and installing plumbing piping and fixtures, electric wiring, conduits and setting and wiring lighting fixtures.

The Panama R. R. furnished, according to the contract, the structural terra cotta, reinforcing bars, cement, sand and gravel at unit prices.



Half Elevation and Half Section of Depressed Road.

Comment.

The building being renaissance in design, seems to carry out the requirements of the site more fully than any other type of structure. No other style of architecture lends itself so well to large plane areas and comparatively low heights.

The colonnades, portiers and porte cocheres lend an airy, cool appearance, as a retreat from the tropical sun.

The color of the building, being so nearly white, is the most appropriate that could be imagined, both from a point of comfort and appearance, as the white absorbs less heat, and harmonizes more perfectly with the blue skies and green verdure of the surrounding tropical vegetation, better than any other color that could have been used.

With the proper attention to landscaping, which the plan would seem to call for and for which there is ample room, the surrounding of this station can be made very attractive and



One of the Two Main Waiting Rooms.

park-like and no doubt this idea will be carried out. A building of this type, partially hidden by trees and flowers, is much more to be admired than the bare building standing severely alone in its architectural beauty only.

The architect is to be commended for solving the problems of topography, fully as much as for the pleasing design and detail of the building itself.

Personnel.

The station was designed by Homer E. Bartlett, architect, under the supervision of Frederick Mears, formerly chief engineer and now general superintendent of the Panama R. R. The contract was carried out by the Central American Construction Co. We are indebted to Mr. Homer E. Bartlett for the information and to Mr. Frederick Mears for the photographs used in preparing this article.

A NEW FORM OF APPLICATION FOR AN ENGINEERING POSITION.

No, gentle reader, this is not an application for a position on the editorial staff of the so-called "popular technical" papers, but for an engineering position with a well-known firm of structural engineers. Some who have been unlucky in landing jobs by written application might try this new style, which might be called the "sublime in engineering." We would advise, however, that the writer be careful to make no calls thereafter unless attended by some one to vouch for and protect him:

"Gentlemen: Youth sometimes sees big constructions—factories, canals, bridges, pillared buildings—in their entirety and at such times wonders, perhaps, at the mighty man-power which made this transformation in crude stone, iron ore, sand. Youth wonders, then, whether any one man, any group of men, any organization of workers was animated with a spirit of power, of efficiently using great strength and so came to do this work, this great material transformation; or whether it was only daily doing of some small tasks and combination of circumstances and experiences which resulted in this. Was this once a great conception, is there any ideality about it, or is it but a great pile of commonplace thoughts and hammer blows? There is no answer—youth must seek. And youth goes out with high hopes of hunting work where he feels that he is working out in materials of the earth a great conception, where he feels that he must do his work intensely, must each day increase the efficiency with which he works. What would you have to say to Youth as you met him seeking?

"All of which is an application for work by an unsatisfied young seeker of the right work for himself."

QUESTION OF GOVERNMENT OWNERSHIP IN GREAT BRITAIN.

The demands of employees of British railways for more pay and better working conditions, resulted in government investigation by committees in 1908 and 1909. The abolition of special favors to shippers, and requests of the railways for an increase in rates has aroused the strenuous and organized opposition of the shippers.

In 1912, a bill was presented to Parliament, allowing the railways to raise rates sufficiently to meet increased expenses. This bill was bitterly opposed by the shippers and only that part of it pertaining to rates was passed, although other portions of the bill were favorable to the shippers.

A new investigation of the subject is now to be undertaken by a Royal commission, which has instructions "to inquire into the relationship between the Railways and the State . . . and report what changes, if any are desirable in that relationship."

The wording of these instructions has been taken to mean that the investigation is to be carried on with government ownership in view. This interpretation of the instructions is wrong; the commission's instructions were intended to give it (the commission) very wide scope, in order that it might deal with all aspects of the subject, including if necessary, but not necessarily, the subject of government ownership.

COMMISSION ON INDUSTRIAL RELATIONS.

Hearings will be held by the United States Commission on Industrial Relations at the principal cities throughout the United States. The object is to determine, if possible, how amicable relations may be established and maintained between employer and employee without sacrificing the rights or thwarting the legitimate ambitions of either. Problems will be taken up relating to unskilled labor, irregularity of employment, labor unions, the relation of courts to labor, vocational education, scientific management, etc., etc.

Convention Report, American Railway Engineering Association

The American Railway Engineering Association convened for the fifteenth annual convention at 9:30 a. m., Tuesday, March 17, in the Florentine Room, Congress Hotel, Chicago. The meeting was opened by Edwin F. Wendt, president, and the minutes of the previous meeting were approved.

PRESIDENT'S ADDRESS.

The fondest hopes of those who organized this association have been realized, and it is not now a question of success, but rather of how strong and useful the association may become.

The finances are in a satisfactory condition, the surplus over expenses in 1913 being \$3,625. This does not accurately show the conditions, it being necessary in addition to consider the

life of the association has increased from 2,300 to 22,200, manual block mileage has increased from 24,000 to 64,555, and the increase in interlocking plants has kept pace.

Marvelous increase has been made in track mileage, especially in Canada, and the U. S. government is planning the construction of 1,000 miles in Alaska.

Great progress has been made in electric traction, a large number of railways having electrified portions, among them the New York, New Haven & Hartford R. R., the Baltimore & Ohio R. R., the New York Central R. R., the Long Island R. R., and the Southern Pacific Co. The mileage of electric traction lines has increased from 20,500 in 1900 to 45,000.

Valuation is a subject of great magnitude and importance.



W. B. STOREY, President



ROBERT TRIMBLE, Vice-President.



A. S. BALDWIN, 2nd Vice-President.

Newly Elected Officers American Railway Engineering Association.

expenses for a period of five years. The Manual will soon have to be reprinted, at an outlay of about \$3,500. The Manual is an expression of "recognized principles" which carry out the prophecy of John F. Wallace, who stated in 1900 that their establishment would tend to the truest and highest economy.

The growth of the association has gradually increased, till it now has 1,200 members, and the work should be broadened by the addition of those engaged in the design of telephones and telegraph and by mechanical engineers, and then new committees of these men appointed to investigate subjects of direct interest to themselves.

The work of the rail committee has received the recognition of all state and federal governments in America; the Board of Direction has appointed a special committee to confer with a committee of the American Society of Civil Engineers to determine stresses in track. The committee on Records and Accounts will in the next five years consider many important subjects relating to valuation. The work of the committee should be extended to include engineering accounting, including a study of the I. C. C. classification accounts, so that this association may take a leading part in any discussion of future changes in them. The committee on Rules and Organization has started a valuable investigation into the science of organization which will be of pronounced educational value to our members.

Pronounced progress has been made in signaling. The amount of automatic blocks and interlocking plants has increased with great rapidity. Block signal mileage during the

This subject involves (1) the law; (2) engineering; (3) accounting; (4) economics. The duty of determining the cost of reproduction rests with the engineers. On account of the lack of records exact original cost will be hard to determine, and some of this work will probably also be done by the engineers, and a detailed inventory must be prepared by them. Depreciation will involve an extended study on the part of engineers, economists, attorneys and accountants.

A work of great magnitude devolves on maintenance and construction engineers in keeping the valuation up to date, after obtained, and in assigning different expenses to operating or capital account. The Board of Direction has considered the appointment of a special committee on this subject, so that the association may lead in the discussion of fundamental principles, many of which remain to be determined.

RULES AND ORGANIZATION—COMMITTEE 12.

G. D. Brooke, chairman; F. D. Anthony, vice-chairman; R. P. Black, J. B. Carothers, S. E. Coombs, C. Dougherty, K. Hanger, B. Herman, Jos. Mullen, E. T. Reisler.

Several changes were suggested in the rules, most of them relating to safety requirements. Rule 4, regarding care to guard against injury, was revised by adding: "They must familiarize themselves with the safety regulations (of the road)." Rule 13 requires that track, structure and signal supervisors must provide their foremen with all rules and instructions, and this was amended by adding, "and safety regulations." A corresponding change was made in Rule No. 18, for track foremen, No. 11 for B. & B. foremen and No. 12 for

signal foremen. Rule 17, under track foremen, regarding attention to interlocking mechanism, was revised by adding: "They must give especial attention to drainage through interlocking plants and where track circuits are used."

General Rules for the Government of Employees of the Construction Department.

General Notice.

- (1) To enter or remain in the service is an assurance of willingness to obey the rules.
- (2) The service demands the faithful, intelligent and courteous discharge of duty.
- (3) Obedience to the rules is essential to the safety of passengers and employees, and to the protection of property.
- (4) Employees must exercise care and watchfulness to prevent injury to themselves, other employees and the public, and to prevent damage to property. In case of doubt they must take the safe course. They must know that all tools and

Preliminary Surveys,

Location Surveys,

Construction.

Chief of Party..... (or Title)

Chief of Party..... (or Title)

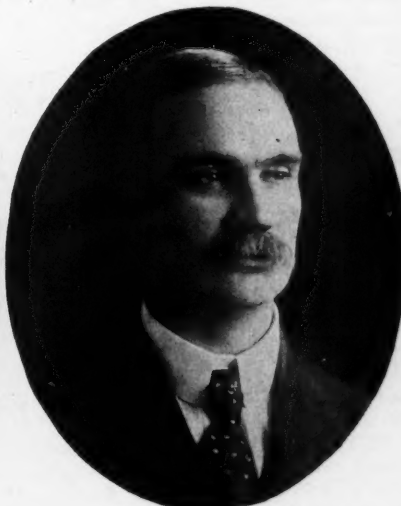
Resident Engineer..... (Or Title)

Rules Governing Chiefs of Party on Preliminary and Location Surveys, and Resident Engineers.

- (1) Chiefs of Party } will report to and receive instructions from the (Title)
Resident Engineers }
- (2) They are responsible for the prosecution of the work in accordance with the general rules and special instructions, and will make such periodical reports as are required.
- (3) They shall keep their parties up to the required strength (Title) and report any prospective vacancies to the
- (4) They are responsible for the proper conduct of the members of their parties and must know that each man is competent to do the work required of him.



E. H. FRITCH, Secretary.



GEO. H. BREMNER, Treasurer.



GEO. D. BROOKE, Chairman
Committee on Rules and Organization.

appliances are in safe condition before using. They must move away from tracks upon approach and during passage of trains, and, so far as practicable, prevent the public from walking on tracks or otherwise trespassing on the right-of-way. They must familiarize themselves with the safety regulations of the road.

(5) Employees must do all in their power to prevent accidents, even though in so doing they occasionally perform the duties of others.

(6) Co-operation is required between all employees whose work or duties may be jointly affected.

(7) Anything that interferes with the safe passage of trains at full speed is an obstruction.

(8) Employees in accepting employment assume its risks.

(9) To obtain promotion, capacity must be shown for greater responsibility.

(10) Employees must not absent themselves from duty, exchange duties with others or engage substitutes.

(11) Employees must conduct themselves properly at all times. They will be courteous to fellow-employees and patrons of the road.

Organization.

(1) The Construction Department in each (District or etc.) is in charge of the (Title) who will report to and receive instructions from the (Title)

(2) The work of the department will be sub-divided under the following heads:

(5) They shall conform to the prescribed standards and plans in the execution of work under their charge.

(6) They must keep their parties supplied with the instruments and materials necessary for the efficient performance of their work, and see that these are properly used and cared for.

(7) They must know that instruments are kept in proper adjustment and that the prescribed accuracy is attained in all their work.

(8) They must not give out information as to the object or character of their work and must refer all inquiries to the (Title)

(9) They shall keep themselves informed in regard to the work of other survey parties operating in their districts and (Title) report to the anything that will have an influence on their work.

(10) They will assume immediate charge of their parties when running lines and staking out important work.

(11) They must know that their parties are provided with rules, standards, circulars, forms, special instructions and safety regulations pertaining to their work, and that they are fully understood by the men to whom they apply.

(12) They shall keep a daily journal of the movements of their parties and the work done, and will enter therein current items of information of which it is advisable to keep record.

SIGNALS AND INTERLOCKING—COMMITTEE 10.

Thos. S. Stevens, chairman; C. C. Anthony, vice-chairman; Azel Ames, H. S. Balliet, W. B. Causey, C. A. Christofferson,

C. E. Denney, W. J. Eck, W. H. Elliott, G. E. Ellis, M. H. Hovey, A. S. Ingalls, J. C. Mock, J. A. Peabody, A. H. Rudd, W. B. Scott, A. G. Shaver.

Economics of Labor in Signal Maintenance.

A study of this subject leads to the conclusion that, in general, no economy could be effected by combining signal and other forces, since each department's employees need a high degree of special training. The cost of training certain bright men for such a position would probably be more than under the present method, because the man's period of inefficiency while acquiring experience would be greatly prolonged. This presumes, of course, that signal forces are organized efficiently now.

Even if it were possible to obtain men with higher education who would learn quickly, the results would be problematical, and such men will specialize, as this brings the quickest returns. At places where the amount of signaling is small, however, a combination of duties would probably be beneficial. Foremen can be taught to take care of minor mechanical adjustments. In automatic territory they can be taught to repair or install bond wires, adjust switches, and maintain insulated joints. It is doubtful if the latter would be more economical, as it involves taking the men away from regular track work.

Combinations might be worked with the bridge and signal men, telegraph, telephone, electrical or mechanical departments, and other duties might be assigned to the signal men. The question is a local one, depending on the capabilities of the different employees. Work outside their departments should not be assigned by a superintendent to employees, however, without conferring with the heads of departments as to the capabilities of the forces in question.

In signal construction there is a better field for co-ordination of forces, as much of the work is familiar to employees of other departments, and a gang of efficient mechanics of all kinds for use on varied construction work offers a good field for an economical general organization. If a system of reports were adopted showing work of the same general nature necessary in the several departments the work could probably be accomplished much more economically. The problem seems a local one, in general, in which labor, traffic and labor conditions are involved, and it seems impossible to evolve a standard practice for all railroads.

The report was submitted as a progress report, with a recommendation that the subject be continued.

Track Circuits.

The conductivity of creosote and creosoted ties was investigated by a series of tests by placing two brass discs 1 in. apart into a beaker containing creosote, by driving spikes at various points in creosoted ties, and by spiking short pieces of rail on ties at standard gauge, readings of resistance then being made in each case.

The resistance between rails on a dry tie was found to be 13,000 ohms; with the same tie after a gallon of water had been poured over it, 12,000 ohms, and after more water was poured over it the resistance decreased to 11,000 ohms. A solution of common salt poured over the tie reduced the resistance to 1,075 ohms.

The results obtained in this experiment would indicate that dry creosoted ties in themselves do not possess very high conductance; nor is their conductance increased to any great extent by the addition of a slight percentage of moisture. The amount of water poured on Sample No. 1 in this test may be assumed as equivalent to a shower on ties in well-drained track. It was impracticable to reproduce conditions experienced in some locations, where the ties may be submerged for hours or days.

The addition of the salt solution brought forth such a great reduction in resistance as to brand this substance as a great detriment to successful track circuit maintenance. While it is

assumed that two pounds of salt per tie represents an extreme case, yet the accumulation of brine from refrigerator cars, year after year, may mean that the residue remaining in the tie will eventually approach the amount used in this test.

The cross grain measurement tends to prove that the resistance is less with the grain than along the year rings or radial lines.

There are approximately 3,200 cross-ties per mile of single track. If all of these possessed the same resistance as the creosote mixture used in treating, and there was leakage of current between rails through no other path, the resultant leakage resistance per mile of track would be 58.7 ohms or 310 ohms per thousand feet.

From the data obtained for Sample No. 1, the following leakage resistances are calculated, it being assumed that all leakage is due to ties alone:

Dry, 4.07 ohms per mile, 21.5 ohms per thousand feet.

Wet, 3.44 ohms per mile, 18.2 ohms per thousand feet.

Salt solution, .336 ohms per mile, 1.77 ohms per thousand feet.

Revision of Manual.

The committee presented the standard R. S. A. symbols, to be inserted in the Manual, superseding those at present in the Manual.

Other Subjects.

Progress was reported on the subject of "Requirements for Switch Indicators." The committee recommended that the subject "Automatic Stops" be dropped, since the American Railway Association has taken it up and appointed a committee consisting of some of the ablest men in the engineering, transportation and mechanical departments.

Appendix A contains "Rules Governing the Construction, Maintenance and Operation of Interlocking Plants." (Published in full on page 29, January, 1914, issue of *Railway Engineering*.)

YARDS AND TERMINALS—COMMITTEE 14.

C. H. Spencer, chairman; E. B. Temple, vice-chairman; W. G. Arn, H. Baldwin, G. H. Burgess, A. E. Clift, H. T. Douglas, Jr., A. C. Everham, R. Ferriday, G. H. Herrold, G. P. Johnson, D. B. Johnston, H. A. Lane, L. J. McIntyre, B. H. Mann, A. Montzheimer, H. J. Pfeifer, S. S. Roberts, W. L. Seddon, E. E. R. Tratman, E. P. Weatherly, W. L. Webb, C. C. Wentworth, J. G. Wishart.

Progress was reported on the subject of "Typical Situation Plans of Passenger Stations," and it was stated that the diagrams submitted in 1913 are about to be put in use at some large terminals.

Developments in the Handling of Freight by Mechanical Means.

The difficulty with mechanical conveying devices is adapting them to conditions of handling (1) sizes and weights of packages of infinite variety, and (2) packages where there are numerous points for receiving and delivering. For the latter conditions the nearest approach to a solution is the small motor truck. Reports were also presented on telfer and conveyor systems, but in general no definite or final conclusions were possible.

Conveyors for Handling Mail or Baggage.

The C. & N. W. Ry. has an interesting installation of belt conveyors at the Chicago terminal for handling mail.

Practically the only method of handling baggage by power at large stations is the electric motor truck. The trucking on passenger platforms is a nuisance and many stations are now designed to handle baggage on a lower floor. The movement of baggage should be restricted as far as possible to subways, overhead lines and special platforms between tracks.

Improvements in Hand Trucking at Freight Stations.

The I. C. R. R. has installed the multiple truck system at a Chicago local freight house. There are five to fifteen trucks

to each trucker and the latter does not have to wait for trucks to be loaded; 50 per cent of the saving is being distributed among the freight handlers in increased pay.

In replacing the telpherage system in the St. Louis freight depot of the M., K. & T. Ry. an attempt was made to reduce the cost of trucking. There are two floors, each with its own group of truckers. Trucks are loaded and placed on elevators, and then raised or lowered to the other floor. Outbound freight is loaded onto the elevator, the trucker then taking off an empty truck and returning to load it. The elevator is then lowered and a trucker on the lower floor wheels on an empty truck and takes off the load.

Conveyors for Express and Parcels.

A belt conveyor is used at the American Express Co.'s station at Thirty-third and Tenth avenue, New York. The loaded wagons back up to an unloading platform which is served by a 40-in. belt conveyor. The packages run up an inclined belt to the upper floor, are discharged onto a revolving turntable cone, and are picked off this cone, as it revolves, by sorters. Other similar systems are used at other express company stations.

Conveyor at Piers and Docks.

One type of pier conveyor consists of a conveyor belt on a truss frame, hinged to a traveling steel tower. Much freight is handled by winches and booms on the ships or by hand



C. H. SPENCER, Chairman
Committee on Yards and Terminals.

trucks. Some piers are fitted with derricks. Small movable cranes on storage battery trucks are also used.

Freight Handling at Warehouses.

At mail order houses elevators are used for ascending packages, and spiral chutes for descending packages. At the foot of the latter is a broad conveyor belt which carries the packages to gravity conveyors, leading off to different parts of the floor. Inclined conveyors from water level to floor are adapted to handle heavy merchandise of all kinds.

Types of Conveyors for Freight Handling.

The telpher system of handling goods by motor trolley hoists is being used extensively. Belt and platform conveyors are being used extensively for horizontal and inclined movements, for short and long distances. A hinged extension can be provided to a conveyor like this to deliver a package at a ship's hatch. A portable cargo conveyor is supported on a truss attached to a tower, which travels along the dock, the conveyor hinged and arranged so that it can be raised or lowered.

Gravity conveyors, consisting of rollers in a side frame, are valuable devices for use on about 4 per cent grades. Packages

travel at a uniform rate on these, but on spiral conveyors a heavy package may overtake or crush a lighter one. Gravity chutes, truck conveyors and motor trucks are used extensively.

Mechanical Handling on English Railways.

With few exceptions elevators and cranes are the only mechanical devices for handling freight at English railway stations. Cranes are used at docks to handle baggage. Electric hoists and special cranes are used at coal shipping ports. Car dumping machines are used for the small cars used on English railways.

Freight and Cargo Handling Appliances at Foreign Ports.

Movable platforms are used to load and unload baggage from ships at Liverpool. An extensive equipment of cranes is provided at this port for handling freight. The cranes are mounted on the roofs of sheds.

At London a firm has installed a conveyor operated by electricity for handling jute or other baled fibres between sheds, for carrying tea from a ship to warehouse and for conveying frozen meats from a ship.

Design and Operation of Hump Yards.

An extensive investigation was carried out on the design, operation and costs per car for operating in hump yards, with comparison of the latter with cost of switching in a flat yard. The following information was obtained: (1). Twenty-eight yards report an average cost in hump yard of 21.2 cents per car; (2). Eleven flat yards report an average cost of 22.91 cents per car; (3). Twenty-two hump yards report an average of 72 cars over the hump per hour; 24 hump yards report their average capacity per 24 hours at 1,973 cars; (4). Of the 15 railroads reporting, 9 make no recommendations in regard to changing grade on hump; 1 submits plans of grades recommended, and 1 found it necessary to make changes in grades recommended in the Manual; (5). Of the 15 roads reporting, 9 have scales on hump and 6 have no scales on hump. Of the 29 yards reported, 19 have scales on hump, 8 have scales in yard and 2 have no scales, either on hump or in yard; (6). An average of the reports from 24 yards indicates that at least 800 cars must be handled daily to warrant the use of a hump yard; (7). Twenty-four yards regulate the number of car riders, according to business in sight; 4 have no definite rule and 1 figures on the basis of 7 cars per rider per hour; (8). Twenty-three yards maintain an extra list of car riders and draw on it as required; 4 yards maintain an extra list of switch tenders and use switch tenders for car riders as required; (9) and (10). Twenty of the yards covered in this report use switch list to indicate cars cut off on the hump; 8 chalk track numbers on the ends of cars, and 1 uses telephone. All report the system they are using as successful; (11) and (12). Reports from 14 railroads covering 29 hump yards show that 16 yards have departure yards, and 13 have no departure yards. Reports from 28 of the yards favor the use of departure yards.

Track Scales.

The committee reported progress on the subject of track scales, and recommended the subject be held over till next year.

Discussion.

Chairman—The use of nearly any mechanical means requires an extra handling of packages, and the number of times handled greatly influences the cost of transportation.

French, B. & O.—Did the committee take into consideration the fact that if the switch to scale track is on ascending grade train must stop each time a car is shunted over the dead rails?

L. A. Downs—Statistics show the average mileage per car in 24 hours is only 30 miles. Terminals should be designed to obstruct or delay the movement of cars as little as possible.

ROADWAY.

W. M. Dawley, chairman; J. A. Spielmann, vice-chairman; M. J. Corrigan, J. R. W. Ambrose, Ward Crosby, W. C. Curd, Paul Didier, R. C. Falconer, S. B. Fisher, Frank Merritt, L. G.

Morphy, W. D. Pence, F. M. Patterson, L. M. Perkins, W. H. Petersen, A. C. Prime, H. J. Slifer, J. E. Willoughby, W. P. Wiltsee.

Unit Pressures Allowable on Roadbed of Different Materials.

J. R. W. Ambrose carried on a number of experiments on the distribution of pressures in a miniature roadbed. A board containing a number of holes was covered with sand embankment, as shown, the pressures being measured at each hole and the diagram shown herewith plotted. The board was jarred to imitate impact, to break down the arch action. The diagram shows the greatest pressure in two peaks, under the two points of application.

Tunnel Construction and Ventilation.

After a study of the subject and investigation and inspection of different tunnels the committee reported its conclusions as follows:

(1) That railway tunnels, as ordinarily constructed in the United States, are more economically built by driving first the



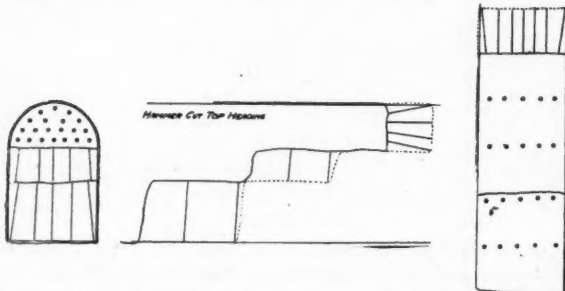
W. M. DAWLEY, Chairman
Committee on Roadway.

heading entirely through, but that such method usually requires a greater length of time for completion of the tunnel.

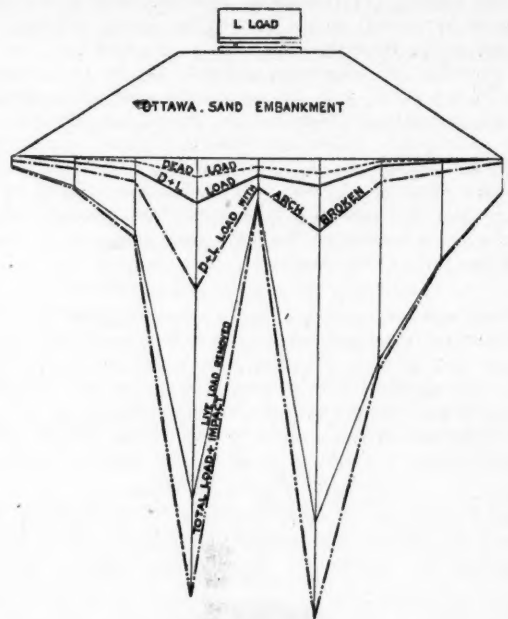
(2) That for material requiring support, the top heading should be usually driven.

(3) That it is economical and expedient to use an electric shovel or an air-shovel, for the removal of the bench where the section of the tunnel permits the safe operation of the same; and that where the material does not require support there are advantages in low cost and quick removal of the bench in driving the heading at the subgrade line.

(4) That where the time limit is of value, the heading and bench should be excavated at the same time, the heading being kept about 50 ft. in advance of the bench. Where the material of roof is not self-supporting and timbering is to be resorted



Method of Tunnel Construction in Hard Rock With Seams.



Typical Diagram Showing Stresses in Experimental Roadway, Embankment of Sand.

to, the bench should not be removed until the wall-plates are laid and the arch ribs (or centering) safely put up.

(5) That opposing grades should never meet between the portals of a tunnel, so as to put a summit in the tunnel, and where practicable, the alignment and ascending grades in the tunnel should be in the same direction as the prevailing winds.

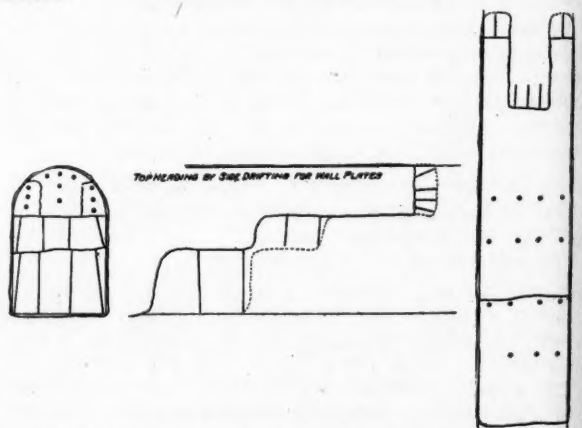
(6) That the attached drawings, Plates I, II and III, are representative of American practice in single-track tunnel construction, where the time limit is of value.

The most practical, effective and economical ventilation of tunnels is obtained by (1) blowing a current of air in the direction train is moving, with sufficient velocity to remove smoke and gases ahead of engine; (2) blowing a current of air against the train sufficient to dilute the gases so that they will not cause passengers or train crew discomfort.

The committee is convinced that tunnels less than one-half mile long do not need artificial ventilation. A large number of installations support this contention.

Economies in Roadway Labor.

The committee reported progress, but recommended that this subject be assigned to the careful study of a special committee.



Method of Tunnel Construction in Soft Rock or Hard Clay.

Discussion.

J. R. Leighty—I have made experiments on a continuous concrete support for track, but found it would be uneconomical for less than 60 trains per day.

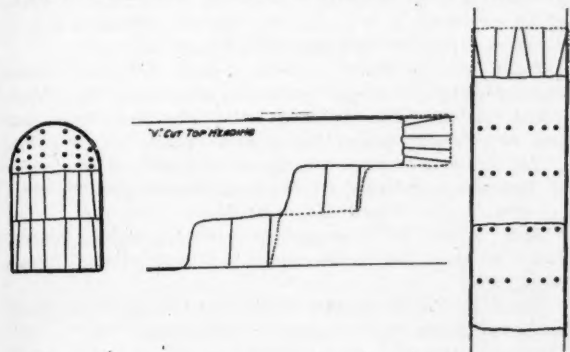
F. E. Turnoure—This subject has some relation to that of "Secondary Stresses," where we found considerable difficulty with short spans. This subject will be an extremely difficult one to get results on.

P. M. La Bach—The practical results obtained agree with the theoretical computations which were worked out by Von Weber in 1867, and later by Dr. Zimmerman.

W. M. Camp—I don't see how the results, if definitely obtained, can be applied to practical conditions. A practical consideration is that on soft bottom, ties can be lengthened, but to preserve corresponding strength they must be thickened proportionately.

J. R. Leighty—We have made impassable tracks passable by interlacing ties in to form a solid floor.

J. G. Sullivan—We have ground that will only support 15 lbs. per square foot at times, and at others will support the



Method of Tunnel Construction in Hard Rock With Few Seams.

weight of a locomotive per square foot. Think the experiments carried on by this committee are valueless. If they can show insufficient depth of ballast they will be valuable. The determination of stresses on curves would be of great value. We have investigated this subject a little and find heavy Pullman cars more destructive than locomotives.

J. L. Campbell—The results of this investigation will give us valuable knowledge, but we can't apply it for lack of money.

C. S. Churchill—We find no trouble in ventilating tunnels with broken grades, and I think that recommendation of the committee should be eliminated.

The chairman agreed to qualify this recommendation by inserting "preferably."

W. H. Courtney—We have trouble ventilating short tunnels with broken grades, but none with long tunnels or straight grades.

H. T. Douglas—There is danger of trains breaking in two in broken grade tunnels.

WOODEN BRIDGES AND TRETTLES—COMMITTEE 7.

E. A. Frink, chairman; W. S. Bouton, vice-chairman; H. Austill, Jr., F. J. Bachelder, J. E. Barrett, F. E. Bissell, E. A. Hadley, W. H. Hoyt, H. S. Jacoby, P. B. Motley, A. O. Ridgway, I. L. Simmons, D. W. Smith, W. F. Steffens, H. B. Stuart.

Formulas for Sheet Piling.

No conclusions were obtained, due to unexpected difficulties and problems, but the committee reports progress. This committee should work with Committee 8, principles of design of retaining walls, as the same principles are involved.

Use of Guard Rails.

The committee sent out a circular letter of inquiry which results in the recommendations given in the conclusions.

Economy of Repairs and Renewals of Trestles.

Considerable progress has been made in collecting data, but definite conclusions have not yet been obtained.

Conclusions.

(1) Amend conclusion 2, as adopted at the last annual meeting, to read as follows:

"It is recommended as good practice, in the installation of guard rails, to extend them beyond the ends of the bridges for such distance as is required by local conditions, but that this distance, in any case, be not less than 50 ft.; that guard rails be fully spiked to every tie, and spliced at every joint; that the guard rails be some form of metal section; and that the ends be beveled, bent down, or otherwise protected against direct impact with moving parts of equipment."

(2) Adopt conclusion 5 to read as follows:

"It is recommended as good practice to use inner guard rails on all open-floor and on the outside tracks of all solid-floor



E. O. FRINK, Chairman
Committee on Wooden Bridges and Trestles.

bridges and similar structures longer than 20 ft. in main-line tracks, and on similar bridges and structures in branch-line tracks on which the speed of trains is 20 miles per hour or more."

Discussion.

J. G. Sullivan—I do not think it a good plan to state 20 miles per hour definitely in (2).

C. E. Lindsay—I think inner guard rails are necessary in some but not in all cases, and think that the question of where they should be installed should be left for local decision.

Chairman—If we don't specify where to put them, State Commissions will, and I think we should lead and not follow them.

G. W. Andrews—Many cases have come to my attention where the guard rail has prevented serious accidents.

J. G. Sullivan—We use guard rails, but are not foolish enough to state our rules for same, as it might give unscrupulous lawyers a chance to make trouble.

A. W. Carpenter—If the bridge is as wide as an embankment, why use a guard rail on one and not on the other?

The chairman's motion that the conclusions be adopted was carried on being put to a vote.

IRON AND STEEL STRUCTURES—COMMITTEE 15.

A. J. Himes, chairman; O. E. Selby, vice-chairman, J. A. Bohland, A. W. Buel, A. W. Carpenter, Charles Chandler, C. L. Crandall, J. E. Crawford, F. O. Dufour, W. R. Edwards, William Michel, W. H. Moore, Albert Reichmann, C. E. Smith, I. F. Stern, G. E. Tebbetts, F. E. Turneure, L. F. Van Hagan.

Methods of Protecting Iron and Steel Structures Against Corrosion—Appendix A.

Pigments may be divided into three classes: (1) those that inhibit or retard rust; (2) those that stimulate rust; (3) and those which have a neutral effect. They may further be divided into "shedding" mixtures, or those which facilitate the run-off of water; or they may be "excluders" which exclude the water until it evaporates. A "shedding" pigment may be a greater absorber than an "excluder" and still be a superior protection, depending on the conditions of location.

Pigments have different coefficients of expansion, and the liability of some of the best inhibitors to crack precludes their use.

The process of manufacture has a marked effect on the action of the pigment on a metal. For instance, Prussian blue may be either inhibitive, neutral, or stimulative. Either light, heat, moisture or gases may have an effect on the chemical composition, which facts probably account for the occasional wide difference of opinion on the same pigment. The vehicle is as important as the base, and the addition of the pigment may make a successful coating of a vehicle objectionable alone, on account of its porosity, etc. The size of the particles of the pigment are conceded to be important, and it is therefore advisable to have varying degrees of fineness in the pigment.



A. J. HIMES, Chairman
Committee on Iron and Steel Structures.

Bituminous coatings are the best metal protectors, but their life is destroyed by sunlight. The following results are deduced from the data obtained:

- (1) Priming coats should always be inhibitors, whether or not they are excluders or shedders.
- (2) Finishing coats should be excluders or shedders; shedders, preferably, whether or not they are inhibitors, neutrals or stimulators.
- (3) Care must be taken to consider the deteriorating influence and determine the chemical requirements of the pigment accordingly.
- (4) In cases where a pigment appears in more than one class, care should be taken to determine its process of manufacture before using it as a priming coat.
- (5) That the best results will probably be obtained by using an "inhibitive" and "excluder" or "shedder" pigment for both priming and finishing coats, due consideration being paid to (3).

From a classification of pigments by Cushing, the committee concludes that carbon and graphite paints should not be used as primers, that zinc and zinc lead pigments are good primers,

while the lead basis may belong to either class, according to the method of manufacture.

Linseed oil is one of the worst excluders, and experiments show it to be one of the greatest stimulators, as a primer coating.

Preservative Coatings for Iron and Steel.

The American Society for Testing Materials has had this subject up for consideration since 1902, has a number of tests going on, and among others, has reached the following conclusions:

"Practically no paint containing linseed oil as a constituent is impervious to water. The fineness of the pigment is a most important element in the water resistance of the layer. Protective coatings which dry by evaporation of the solvent seem to offer much more prospect of success. If our experiments are to be trusted, the protective coatings at present available are not as valuable as we have been hoping." Dudley, Vol. IV, 1904.

"Cement coatings must be kept in moist air at least 24 hours after being applied. Cement in extremely fine state of division will be necessary; 5 to 10 per cent. calcium chloride makes it set before drying." Newberry, Vol. IV, 1904.

"Paint must be rubbed in with a good stiff round brush. Proper cleaning and proper application of primary importance. Average quality of wood painting better than iron. Paint, then cover with paraffin paper, then paint." Sabin, Vol. IV, 1904.

"Tar residuum of petroleum mixed with some of the lighter oils (petroleum products) is the best preservative for train shed steel." De Wyrall, Vol. IV, 1904.

"Some of the ferric oxides are perfectly stable, are not affected by gases, and cannot change their composition." Toch, Vol. V, 1905.

"Use of flat brush should be prohibited. Round brush larger than a 6-0 should not be allowed." Cheesman, Vol. V, 1905.

The committee also quoted from a report of the American Railway Bridge and Building Association's report on paints. (An abstract of this report was printed in the November, 1912, issue of *Railway Engineering*.)

From reports of railways in answer to requests, it was shown that concrete should be protected from locomotive blast. Steel plate, cast iron (exposed surface chilled), and vitrified and clay tile have proven effective. Four roads recommend concrete encasement, with blast boards, for protecting overhead highway bridges.

Concrete Encasement.

Concrete, properly applied, is an ideal protection for steel. Protecting by painting under crossings and city bridges is unsatisfactory and costs in the neighborhood of \$1.25 per ton per year; an ordinary concrete encasement 3 in. thick costs about 25 cents per square foot. Gun encasements can be put on for about 23 cents per square foot of floor.

The cement gun is being used at the Grand Central Terminal for applying a protective coating, with an average thickness of from 2½ to 3 inches. A wire mesh reinforcement is used, fastened to quarter-inch rods, bent around and fastened to the steel. A 1 to 3 mixture is usually used, but 1 to 2 is used where structure is vibrating, as it sticks better. A cubic foot weighs 144 pounds if applied with the gun, but only 127 pounds is applied by trowel. From 20 to 25 per cent. of the mixture is lost, some bounces off, some is shot past the steel, and some is scraped off by the mason in finishing. The machine is operated by a force of one foreman, one machine operator, one nozzleman, two masons for floating, and four laborers screening and mixing the aggregates, and charging the machine. This method would appear to give an excellent protection.

Other reports were cited, showing the excellent protection afforded by concrete, but showing that protection from locomotive blast is necessary.

An experiment was carried on by G. E. Tebbetts, bridge engineer, K. C. T. Ry., on the efficiency of asbestos for blast boards. Asbestos boards were subjected to a very severe blast

for eleven months, with practically no cutting, showing asbestos to be an excellent material for blast boards.

Column Tests, Appendix B.

This committee is co-operating with a similar committee of the American Society of Civil Engineers; the tests of the U. S. Bureau of Standards are now being conducted, and the first one was witnessed by the committee Jan. 20, 1914. No conclusions have been reached as yet.

Secondary Stresses, Appendix C.

A very comprehensive report was submitted by the sub-committee, Professor F. E. Turneaure, chairman. The theory is given in full, as well as results of a number of field tests. A comparison was made of the theoretical computations and practical results obtained in:

- (1) Bending stresses in the plane of the main truss due to rigidity of joints, eccentricity of joints and weight of members.
- (2) Bending stresses in members of a transverse frame due to the deflection of floor beams, and primary stresses in posts.
- (3) Stresses in a horizontal plane due to longitudinal deformation of chords, especially the stresses in floor beams and connections.
- (4) Variation of axial stress in different elements of a member.
- (5) Stresses due to vibration of individual members.

Requirements for the Protection of Movable Bridges.

The protective devices may be classified under the headings:

- (A) Interlocking power and bridge devices.
- (B) Bridge surfacing, aligning and fastening devices.
- (C) Rail end connections.
- (D) Signaling and interlocking.
- (E) Guard rails.

The order of operations is as follows, for a swing bridge with all devices operated from one location on the draw span:

TO OPEN DRAWBRIDGE	TO PASS TRAINS OVER DRAWBRIDGE.
Display stop signals.	1. Close bridge.
Unlock derails.	2. Insert bridge surfacing, aligning and fastening devices.
Open derails.	3. Insert rail end connections.
Uncouple interlocking connections.	4. Lock bridge surfacing, aligning and fastening devices.
Unlock rail end connections.	5. Lock rail end connections.
Unlock bridge surfacing, aligning and fastening devices.	6. Couple interlocking connections.
Withdraw rail end connections.	7. Close derails.
Withdraw bridge surfacing, aligning and fastening devices.	8. Lock derails.
Open bridge.	9. Display clear signals.

Bridge Clearance Diagram—Appendix E.

A circular letter was sent out to ascertain the sentiment as to whether the standard bridge clearance diagram should be widened out to provide for third rail, or whether a modification should be made, and an entirely new diagram prepared for third rail.

Conclusions.

Your committee recommends that the following action be taken on the report submitted herewith:

- (1) That the report on methods of protection of iron and steel structures against corrosion be received as information.
- (2) That the report on secondary stresses be received as information.
- (3) That the report on requirements for the protection of traffic at movable bridges be adopted and published in the Manual.
- (4) That the report on bridge clearance diagram be received as information.
- (5) That revised paragraph 23 of "Instructions for the Inspection of the Fabrication of Steel Bridges" be adopted

and published in the Manual. That the two additional clauses relating to the same subject be adopted and published in the Manual.

Discussion.

W. H. Moore.—The paragraph (c) submitted eliminates the mitred rail, which I think is desirable in some cases, on account of its smooth riding.

A. H. Rudd.—I think mitred rails are a good thing for lift bridges, and do not see why they are not for swing bridges also. I move that the motion be amended to allow use of mitred rails.

C. H. Stein, E. A. Frink and G. J. Ray advocated that the use of mitred rails be permitted.

A. W. Carpenter.—My experience with the mitred rail has not been in accord with that of the previous speakers. The lift rails failed to work in one case and there was an accident. The mitre rail does not seem to be so well adopted to interlocking, nor does it hold up under heavy axle loads.

B. R. Leffler and H. R. Safford advocated the square end rail exclusively.

A. J. Himes.—There are a lot of mitre rails in use which have given satisfaction, its strongest merit being that it can be spiked right up to the bridge.

Mr. Rudd's amendment was put to a vote, and carried, allowing the use of either square end or mitre joints.

A motion was made to withdraw Appendix D and postpone it till next year, and the motion was carried.

C. E. Lindsay.—I move the subject of "Bridge Clearance Diagram" be referred to the Committee on Electricity. Motion carried.

The amendments to the instructions were adopted.

MASONRY.

(The report on "Masonry" appears in the Concrete Department, page 182.)

TRACK—COMMITTEE 5.

J. B. Jenkins, Chairman; G. J. Ray, Vice-Chairman; Geo. H. Bremner, H. M. Church, Garrett Davis, Raffe Emerson, J. M. R. Fairbairn, T. H. Hickey, E. T. Howson, L. J. F. Hughes, J. R. Leighty, Curtiss Millard, P. C. Newbegin, F. B. Oren, H. T. Porter, E. Raymond, W. G. Raymond, L. S. Rose, H. R. Safford, C. H. Stein, F. S. Stevens, A. H. Stone.

Main Line Turnouts and Crossovers.

Typical plans of Nos. 8, 11 and 16 crossovers have been prepared, and a study made of double slip crossings. The tables of dimensions of the latter are from various designs and include those suggested by the committee.

In preparing the typical plans it was endeavored to make them harmonize with the Table of Practical Leads, and Typical Plans of Turnouts already adopted by the association.

Speed of Trains on Curves and Turnouts.

The committee developed the formula:

$$\tan (k + y) = \frac{C}{W} = .0000167 D \cdot V^2$$

in which

x = cant of track = angle of axis of track with the vertical.

y = angle of resultant of forces with axis of track.

c = centrifugal force.

w = weight.

D = degree of curve.

V = velocity in miles per hour.

The quantities x and y are obtained from the formula:

$$\sin x = \frac{E}{G}$$

$$\sin y = \frac{G}{E}$$

in which

E = elevation for curvature.

G = gage of track.

Turnout		Speed
Frog Number	Length of Switch	Miles per Hour
4	11	9
5	11	12
6	11	13
7	16.5	17
8-10	16.5	20
11-14	22	27
15	33	37
16-24	33	40

Speeds on Turnouts.

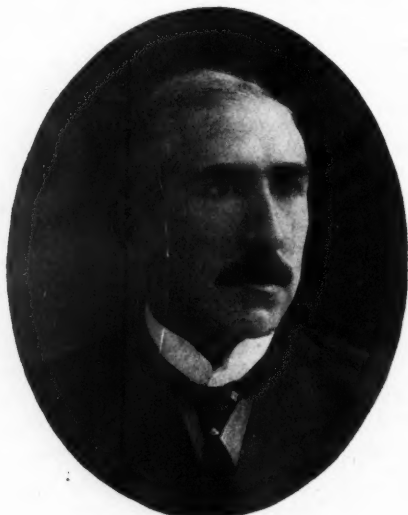
A = distance on plane of track, from axis of track to line of resultant forces (F).

B = distance from center of gravity to axis of track.

H = height of center of gravity above top of rail.

H and B for locomotives are obtained from tables furnished by the locomotive companies. (Not shown here.)

Under compression of springs, the upper part of the engine revolves about a horizontal central axis about 40 inches above the rail; the maximum vertical movement of the springs from normal position is about $\frac{1}{4}$ inch, at a distance of about 2 feet 4 inches from the center of the engine; the resulting swing from one side to the other of a point in the vertical axis of the



J. B. JENKINS, Chairman
Committee on Track.

engine, 84 inches above the rail, is

$$84 \div 40 \times \frac{1}{4} \text{ in.} = 11 \frac{1}{4} \text{ in.} = 1 \frac{1}{8} \text{ in.}$$

Gage of wheels, back to back of flanges..... $53 \frac{3}{8}$ in.
Add two flanges of minimum thickness..... 2 "

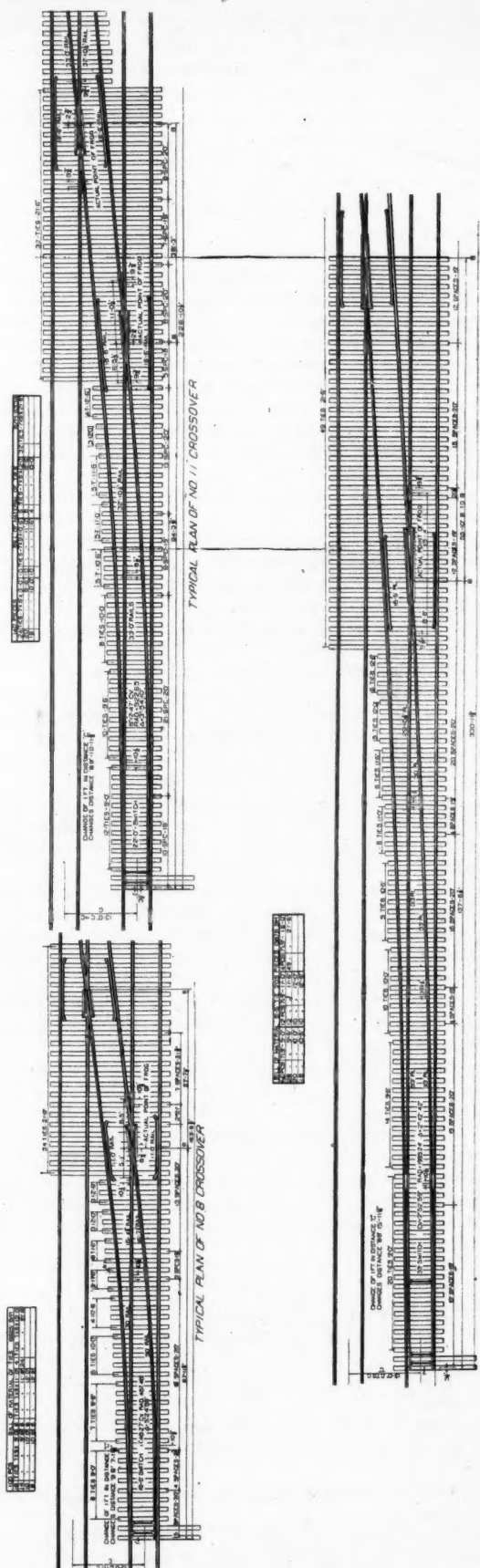
Minimum gage of wheels, front to front of flanges..... $55 \frac{3}{8}$ in.
Gage of track..... $56 \frac{1}{2}$

Maximum play between worn wheels and standard gage track $1 \frac{1}{8}$ in.
Play on axle..... $\frac{5}{8}$

Total lateral play not affected by degree of curve.... $2 \frac{3}{8}$ in.

The distance B equals $\frac{1}{2}$ of $2 \frac{3}{8}$ in., plus half the widening of gage due to worn rail, plus half the widening of gage for curvature, less the middle ordinate of the curve for a length equal to the wheel-base.

To ascertain the speed which will cause the resultant of force to intersect the plane of the track at any given point (k), first obtain (x) and (y) from the equations and solve for (V).



Typical Plans of Nos. 8, 11, and 16 Crossovers.

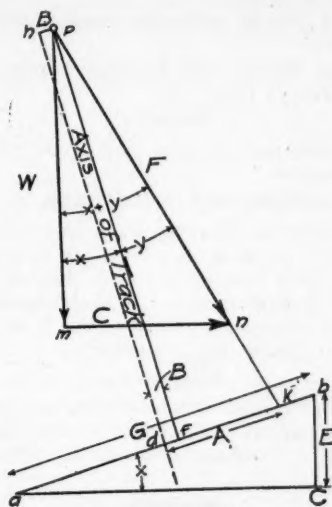


Diagram Illustrating Effect of Elevation of Outer Rail on a Locomotive Rounding a Curve.

B is assumed at 1½ in. and g at 57 in. These are approximations, but the error is small and on the side of safety.

The following tables show overturning speeds calculated by the above formula:

SPEEDS OF TRAINS ON CURVES

Height of Center of Gravity 84 in.
Resultant of Forces through Gage Line

Degree of Curve	Elevation in Inches								
	0	1	2	3	4	5	6	7	8
1°	165.9	170.9	175.8	180.6	185.3	190.0	194.7	199.4	204.0
1°30'	135.5	139.5	143.5	147.4	151.3	155.1	159.0	162.8	166.5
2°	117.3	120.8	124.3	127.7	131.1	134.3	137.7	141.0	144.2
2°30'	104.9	108.1	111.2	114.2	117.3	120.1	123.1	126.1	129.0
3°	95.8	98.7	101.5	104.3	107.0	109.7	112.4	115.1	117.8
3°30'	88.7	91.3	94.0	96.5	99.1	101.5	104.1	106.6	109.0
4°	82.0	84.4	87.9	90.3	92.7	95.0	97.4	99.7	102.0
4°30'	76.2	78.6	82.0	84.1	87.4	89.6	91.8	94.0	96.2
5°	71.2	73.6	76.8	79.8	82.9	85.0	87.1	89.2	91.3
5°30'	67.7	69.8	71.8	73.7	75.7	77.6	79.5	81.4	83.3
6°	65.2	67.1	69.0	70.8	72.6	74.4	76.2	78.0	79.8
6°30'	62.7	64.4	66.1	67.8	69.5	71.2	72.9	74.6	76.3
7°	60.4	62.1	63.8	65.4	67.1	68.7	70.4	72.1	73.7
7°30'	58.3	59.9	61.5	63.1	64.7	66.3	67.9	69.5	71.1
8°	56.3	57.8	59.3	60.8	62.3	63.8	65.3	66.8	68.3
8°30'	54.3	55.8	57.2	58.7	60.1	61.6	63.0	64.5	65.9
9°	52.3	53.7	55.1	56.5	57.9	59.3	60.7	62.1	63.5
9°30'	50.3	51.6	52.9	54.2	55.5	56.8	58.1	59.4	60.7
10°	48.3	49.5	50.7	51.9	53.1	54.3	55.5	56.7	57.9
10°30'	46.3	47.4	48.5	49.6	50.7	51.8	52.9	54.0	55.1
11°	44.3	45.3	46.3	47.3	48.3	49.3	50.3	51.3	52.3
11°30'	42.3	43.2	44.1	45.0	45.9	46.8	47.7	48.6	49.5
12°	40.3	41.1	41.9	42.7	43.5	44.3	45.1	45.9	46.7
12°30'	38.3	39.0	39.7	40.4	41.1	41.8	42.5	43.2	43.9
13°	36.3	36.9	37.5	38.1	38.7	39.3	39.9	40.5	41.1
13°30'	34.3	34.8	35.3	35.8	36.3	36.8	37.3	37.8	38.3
14°	32.3	32.7	33.1	33.5	33.9	34.3	34.7	35.1	35.5
14°30'	30.3	30.6	31.0	31.3	31.7	32.0	32.3	32.7	33.0

SPEEDS OF TRAINS ON CURVES

Height of Center of Gravity 84 in.
Resultant through Edge of Middle Third

Degree of Curve	Elevation in Inches								
	0	1	2	3	4	5	6	7	8
1°	90.3	98.4	105.9	112.9	119.6	125.9	132.0	137.9	143.4
1°30'	72.7	80.3	86.4	92.3	97.6	102.8	107.8	112.6	117.2
2°	63.9	69.5	74.9	79.8	84.5	88.0	91.3	94.5	97.5
2°30'	57.1	62.2	67.0	71.4	75.8	79.6	83.5	87.2	90.8
3°	52.1	56.8	61.1	65.0	68.0	72.7	76.3	79.8	82.9
3°30'	48.3	52.6	56.6	60.3	63.9	67.3	70.6	73.7	76.7
4°	45.2	49.3	53.9	57.5	60.8	63.9	66.0	68.9	71.7
4°30'	42.6	46.4	49.9	53.3	56.4	59.4	62.3	65.0	67.7
5°	40.4	44.0	47.3	50.5	53.5	56.3	59.0	61.7	64.3
5°30'	38.9	42.3	45.3	48.1	50.8	53.4	55.9	58.3	60.6
6°	37.1	40.3	43.2	45.9	48.5	51.0	53.5	55.9	58.2
6°30'	35.6	38.6	41.4	44.0	46.5	48.9	51.3	53.6	55.8
7°	34.1	37.0	39.7	42.3	44.7	47.1	49.4	51.7	53.9
7°30'	32.6	35.3	37.9	40.3	42.7	45.0	47.3	49.5	51.7
8°	31.0	33.6	36.1	38.5	40.8	43.1	45.3	47.5	49.6
8°30'	29.5	32.0	34.4	36.7	39.0	41.2	43.4	45.6	47.7
9°	28.0	30.4	32.7	35.0	37.2	39.4	41.6	43.7	45.8
9°30'	26.5	28.8	31.0	33.2	35.3	37.4	39.5	41.6	43.6
10°	25.0	27.2	29.3	31.4	33.5	35.5	37.5	39.5	41.5
10°30'	23.5	25.6	27.6	29.6	31.6	33.6	35.6	37.6	39.5
11°	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0
11°30'	20.5	22.4	24.3	26.2	28.1	30.0	31.9	33.8	35.6
12°	19.0	20.8	22.6	24.4	26.2	28.0	29.8	31.6	33.4
12°30'	17.5	19.2	21.0	22.7	24.4	26.1	27.8	29.5	31.2
13°	16.0	17.6	19.2	20.8	22.4	24.0	25.6	27.1	28.7
13°30'	14.5	16.0	17.5	19.0	20.5	22.0	23.5	25.0	26.5

SPEED AND UNBALANCED ELEVATION FOR CURVATURE.

Speed and Unbalanced Elevation for Curvature.

Using the formula given herewith, the committee calculated

speeds of train through curves and turnouts having elevations 3 in. less than the theoretical elevation.

The motion through a straight switch point is angular and there is no direct comparison between it and the motion on a curve. The committee made a rough comparison, figuring a curve with a central angle equal to the switch angle, and a chord equal to the length of the switch rail.

The following rules will give the approximate speeds through level turnouts, with center of gravity 84 inches above track:

Resultant through gage line — speed = 6.1 N ±.

Resultant through edge of middle third — speed = 3.3 N ±.

Three inches unbalanced elevation — speed = 2.46 N ±.

The horizontal thrust at the point due to the static friction figures

$$T = 0.14 W.$$

The committee was unable to collect definite information on the subject of "Relation Between Worn Flanges and Worn Switch Points," or on "Standard Plans of Guard Rails."

Economics of Track Labor.

The committee recommended that studies be continued with regard to increasing the scope of the duties of foremen; some reports on this subject indicated that the combination of duties was a failure, while other reports indicate that the experiment will be successful.

Equating Track Values.

The committee has worked out a plan for a thorough test on the equating of track values, to extend over a period of one year, to determine the following:

(1) To arrive at proper units of cost of the various features which enter into track labor expense.

SPEEDS OF TRAINS THROUGH TURNOUTS

Height of Center of Gravity 84 in.
Resultant of Forces through Gage Line.

Frog No.	Degree of Lead Curve	Length of Switch	Elevation in Inches			
			0	1	2	3
4-6	33°43'34"	11	34.1	35.1	36.1	37.1
4	33°19'37"		22.6	23.3	24.0	24.6
6	21°43'04"		28.7	29.6	30.4	31.3
			35.9	37.0	38.0	39.0
7-10		16.5	51.1	52.7	54.2	55.7
7	18°52'39"		41.7	43.0	44.3	45.6
8	11°46'27"		48.4	49.8	51.2	52.6
9	9°28'43"		63.9	65.5	67.1	68.7
10	8°14'45"		57.9	59.5	61.2	62.9
	7°15'18"		61.8	63.5	65.3	67.1
11-14		23	68.2	70.3	72.3	74.3
11	6°12'47"		66.6	68.6	70.5	72.4
13	8°12'39"		72.7	74.8	77.0	79.1
15-24		33	102.3	106.4	108.4	111.3
15	3°17'10"		91.1	94.3	97.0	99.7
16	2°52'39"		97.7	100.6	103.5	106.4
17	2°14'31"		110.9	114.1	117.4	120.6
18	1°43'32"		128.9	132.9	136.8	140.7
24	1°10'21"		153.3	157.9	162.4	166.8

SPEEDS OF TRAINS THROUGH TURNOUTS

Height of Center of Gravity 84 in.
Resultant Through Edge of Middle Third.

Frog No.	Degree of Lead Curve	Length of Switch	Elevation in Inches			
			0	1	2	3
4-6	33°43'34"	11	18.6	20.2	21.8	23.3
4	33°19'37"		12.3	13.4	14.4	15.4
6	21°43'04"		15.6	17.0	18.3	19.6
			19.5	21.3	22.9	24.4
7-10		16.5	37.8	39.5	41.2	42.9
7	18°52'39"		22.7	24.7	26.6	28.4
8	11°46'27"		26.3	28.7	30.9	32.9
9	9°28'43"		29.3	32.0	34.4	36.7
10	8°14'45"		31.4	34.3	36.9	39.3
	7°15'18"		33.5	36.5	39.3	41.9
11-14		23	37.1	40.4	43.5	46.4
11	6°12'47"		36.2	39.5	42.5	45.3
13	8°12'39"		39.5	43.1	46.4	49.4
15-24		33	55.7	60.7	65.3	69.4
15	3°17'10"		49.5	54.3	58.4	62.3
16	2°52'39"		53.2	57.9	62.4	66.3
17	2°14'31"		60.3	66.7	72.7	78.4
18	1°43'32"		66.1	74.2	79.8	85.1
24	1°10'21"		80.4	90.9	97.5	104.3

(2) To arrive at a basis for equitably apportioning appropriations for expenditure.

(3) To obtain a systematic measure of efficiency of track foremen and men.

Revision of Manual.

The committee found an error in the Table of Practical Leads, published in the Manual, and submitted a corrected table.

SPEEDS OF TRAINS THROUGH TURNOUTS

Three Inches of Unbalanced Elevation. All Heights of Center of Gravity. Those Speeds of Trains through Turnouts having an Elevation of 3 Inches less than the Theoretical Elevation.*						
Frog No.	Degree of Lead Curve	Length of Switch	Actual Elevation in Inches			
			0	1	2	3
4-6		11	13.9	16.0	17.9	19.6
4	53°42'34"		9.3	10.6	11.9	13.0
5	23°19'37"		11.7	13.5	15.1	16.6
6	21°43'04"		14.6	16.9	18.9	20.7
7-10		16.5	20.8	24.0	26.9	29.5
7	15°43'30"		17.0	19.6	21.9	24.0
8	11°49'27"		19.7	22.7	25.4	27.9
9	9°26'43"		21.9	25.3	28.3	31.1
10	8°14'45"		23.5	27.1	30.4	33.3
11-14		22	27.7	32.0	35.9	39.3
11	6°12'47"		27.1	31.3	35.0	38.4
12	5°12'59"		29.5	34.1	38.2	41.9
15-24		33	41.6	48.1	53.8	59.0
15	3°17'10"		37.2	43.0	48.1	52.8
16	2°32'29"		39.7	45.9	51.4	56.5
17	2°14'21"		45.1	52.1	58.3	63.9
18	1°45'32"		50.9	58.8	65.8	72.1
19	1°10'21"		62.3	72.0	80.6	88.3

*See text under "Speed and Unbalanced Elevation for Curvature."

SPEEDS OF TRAINS THROUGH LEVEL TURNOUTS

Height of Center of Gravity 54 in. Resultant Through Points at Varying Distances from Center Line.								
Frog No.	Length of Switch	Distance of Resultant from Center Line of Track						
		2'	4'	6'	8'	10'	12'	14'
4-6	11	4.6	10.4	13.9	16.7	19.1	21.3	23.2
4		3.1	6.9	9.3	11.1	12.7	14.1	15.4
5		3.9	8.7	11.7	14.1	16.1	17.9	19.5
6		4.9	10.9	14.6	17.6	20.1	22.4	24.4
7-10	16.5	7.0	15.6	20.9	25.1	28.7	31.9	34.8
7		5.7	12.7	17.0	20.5	23.4	26.0	28.4
8		6.6	14.7	19.7	23.7	27.1	30.1	32.9
9		7.3	16.4	22.0	26.4	30.2	33.6	36.7
10		7.9	17.6	23.6	28.4	32.4	36.0	39.3
11-14	22	9.3	20.7	27.8	33.5	38.3	42.5	46.4
11		9.1	20.3	27.2	33.4	37.4	41.5	45.3
12		9.9	22.1	29.7	35.6	40.8	45.3	49.4
15-24	33	13.9	31.1	41.8	50.2	57.4	63.8	69.6
15		12.5	27.9	37.4	44.9	50.2	57.1	62.3
16		13.3	29.7	39.9	47.9	54.8	60.9	66.5
17		15.1	33.7	45.2	54.3	62.2	69.1	75.4
18		17.0	38.1	51.1	61.4	70.2	78.0	85.1
19		20.9	46.6	62.6	75.2	86.0	96.6	104.9

The speeds in the foregoing tables are graphically represented in the following diagrams.

Conclusions.

Your committee recommends for adoption and publication in the Manual:

(1) Typical plans of Nos. 8, 11 and 16 crossovers, as representing good practice.

(2) The five diagrams of speeds of trains through curves and level turnouts.

(3) The following table, showing relative speeds through level turnouts, to give the equivalent riding condition to track elevated three inches less than theoretically required.

(4) The corrections to Table of Theoretical and Practical Switch Leads recommended under "Revision of Manual."

Your committee recommends receiving as information:

(1) Typical plans of Nos. 8, 11 and 16 double-slip crossings.

(2) Cleveland, Cincinnati, Chicago & St. Louis plans of standard No. 8 double-slip switch.

(3) The report on "Speeds of Trains on Curves and Turnouts."

Your committee recommends receiving as a progress report, the report on Economics of Track Labor.

Your committee recommends recommending for further study:

(1) Typical plans for double-slip crossings, double crossovers and guard rails.

(2) Relation between worn flanges and worn switch-points.

(3) Economics of Track Labor.

Discussion.

The conclusions were accepted, with minor corrections, and with little discussion.

ELECTRICITY—COMMITTEE 16.

George W. Kittredge, Chairman; J. B. Austin, Jr., Vice-Chairman; D. J. Brumley, R. D. Coombs, A. O. Cunningham, Walt Dennis, L. C. Fritch, George Gibbs, G. A. Harwood, E. B. Katte, C. E. Lindsay, W. S. Murray, J. A. Peabody, Frank Rhea, J. W. Reid, A. F. Robinson, J. R. Savage, A. G. Shaver, Martin Schreiber, W. I. Trench, H. U. Wallace.

Clearances.

The committee reached definite conclusions, and submitted clearance diagrams for (1) overhead clearance for trainman with lantern; (2) overhead clearance for trainman without



GEORGE W. KITTREDGE, Chairman
Committee on Electricity.

lantern; (3) normal minimum clearance without trainman on cars; (4) special minimum clearance without trainman on cars; (5) minimum clearance, D. C. overhead.

Electrolysis.

A special sub-committee met with the Joint National Committee on Electrolysis. A committee was delegated to outline the scope, organization and plan of work. The work is now being deferred awaiting the appointment of members from the American Gas Institute, the American Water Works' Association, and the Natural Gas Association of America.

Recommendations.

(1) Your committee recommends the adoption by the association of Diagram "B," showing typical overhead clearance diagram for permanent way structures and working conductors.

(2) Your committee also recommends the continuation during the coming year of consideration of work now under way, particularly the consideration of the subjects of "Electrolysis," "Insulation," and "Location and Clearance of Automatic Safety Stops," and also the consideration of any new information that may develop in reference to "Maintenance Organization" and "Relation to Track Structures."

(3) Your committee asks for such other directions or instructions as seem necessary or desirable.

Discussion.

The recommendations were accepted without discussion. E. B. Temple suggested that the committee look up the matter of

clearances, in regard to places where trainmen may remain on top of cars.

WOOD PRESERVATION—COMMITTEE 17.

Earl Stimson, Chairman; E. H. Bowser, Vice-Chairman; H. B. Dick, C. F. Ford, Dr. W. K. Hatt, V. K. Hendricks, Jos. O. Osgood, George E. Rex, E. A. Sterling, C. M. Taylor, Dr. H. von Schrenk, T. G. Townsend, committee.

Oil from Water Gas and Coal Tar in Creosote Oil.

The Forest Service has made tests on Oil from Water Gas Tar, which indicate as good penetration, but poorer diffusion than creosote.

On account of the present lack of definite data as to its efficiency, its rising price and the uncertainty of its preservative value, it is thought inadvisable at this time to recommend the use of oil from water-gas tar as a wood preservative.

The information collected on the use of Refined Tar in creosote oil indicates that it is being extensively used, but that its technical application has not been reduced to defined practice. It is our opinion that grade I Coal Tar Creosote should not be used in the mixture, when the mixture is used. If refined tar must be used in the poorer grades of creosote, special precautions should be taken.

Records from Service Tests.

A complete tabulated report was submitted on test sections on a number of roads, some of which have not been under way long enough to give definite results. Interesting results, however, have been obtained on the C., B. & Q. R. R., the G. H. & S. A. Ry., the N. Y., N. H. & H. R. R., the Norfolk Southern R. R. and the St. L. & S. F. R. R.

Grouping of Timbers for Antiseptic Treatment.

The committee reported nothing new in regard to Grouping of Timbers, but advised that additional experiments were to be undertaken.

Methods of Accurately Determining the Absorption of Creosote Oil.

The systems for measuring the amount of absorption now in general use are:

(1) By gage readings of tanks, with temperature corrections; (2) by weighing the oil in the working tanks before and after treatment of charges in cylinder; (3) by weighing the cylinder charges before and after treatment.

Appendix A.

The use of Refined Coal Tar in the Creosoting Industry was treated in an exhaustive, illustrated article by Hermann von Schrenk and Alfred L. Kammerer. The conclusions reached are given herewith:

SUMMARY.

Summarizing the factors presented, we find:

I. Amount Used.

Since 1908 approximately 24,500,000 ties have been treated with a combination of 80 per cent creosote oil and 20 per cent refined coal tar. Practically all paving blocks since 1907 have been treated with such a combination. The total amount of creosote oil used in the United States in 1912 was 83,666,490 gallons. During 1912 it is estimated that 12,500,000 gallons of coal tar-creosote combination were used for the treatment of ties, and about 14,000,000 gallons for paving blocks, or a total of 28,000,000 for both, or about 31 per cent of all the oil used. Adding to this similar oil used at plants from which no figures are available, a conservative estimate indicates that about 40 per cent of all the creosote oil used in 1912 was a coal tar-creosote combination.

II. What Coal Tar Is.

Coal tar is one of the products obtained from the destructive distillation of coal, either at retort gas works or at by-product coke oven plants, and the tar so obtained is gas house tar or coke oven tar. Gas house tar usually has a high percentage of free carbon, coke oven tar a low percentage of free carbon. Both tars when redistilled yield creosote oil, that is, the coal

tar is the mother liquor from which creosote oil is obtained. Only a low-carbon tar should be used for addition to creosote oil.

III. Previous Uses of Coal Tar.

Coal tar was added to creosote oil in large quantities in the early days of creosoting, and is still added to creosote oil in England to give a black color to creosoted wood.

IV. What Happens When Coal Tar Is Added to Creosote Oil.

When coal tar is added to creosote oil, the two substances, being composed of the same chemical compounds, unite. The combination is in the nature of a "solution," and it is not merely a physical "mixture." When thoroughly mixed, they do not separate. The addition of coal tar to creosote oil cannot be called an "adulteration."

The addition of a small amount of coal tar to creosote oil reduces the amount of evaporation which takes place. The combination remains in wood longer than the same creosote oil without the coal tar addition.

V. Relative to Antiseptic Properties.

The experience of many years has shown that the high-boiling constituents of creosote oil are the most effective in preserving wood. Coal tar is largely composed of high-boiling compounds. The presumption therefore is that by adding a small amount of coal tar to creosote oil the antiseptic value of the mixture is not reduced, but may be enhanced.

VI. Relation to Penetration.

Tests at treating plants and under exact conditions show that the penetration obtained with a combination of 80 per cent creosote oil and 20 per cent refined coal tar is as good as that obtained with good creosote oil. In any event, a slight increase in the time of pressure will give as high a penetration as can be obtained with the lighter creosote oils.

VII. Relation to Supply and Cost.

Only a limited supply of high-grade creosote oil is available, whereas large quantities of lower-grade creosote oils are on the market. With the economical creosoting processes now used, injecting small quantities of oil into timbers, it is desirable to retain as much oil in the wood as possible. Low-grade oils lose a large percentage in a very few years. Anything which will retard this loss will make it possible to use these lower-grade oils to good advantage. One of the principal reasons for adding coal tar to these lower-grade oils is to make them better adapted to the economical creosoting processes, and at no increase in cost.

VIII. Conclusions.

The chief object of this discussion has been to present results of certain experiments made during recent years with creosote oil to which low carbon coal tar had been added. The writers firmly believe that the best results with creosoting will always be obtained by the use of oil equivalent to the American Railway Engineering Association No. 1 oil. They wish to point out distinctly that, in their opinion, the refined coal tar should never be added to American Railway Engineering Association No. 1 oil. The information available seems to indicate that the addition of low-carbon coal tar to oils inferior to American Railway Engineering Association No. 1 specification oil does not reduce the penetration obtainable, provided suitable methods are adopted at the creosoting plants to bring about the proper mixture and injection. They find also that little risk is taken from the antiseptic standpoint. The results also seem to indicate that the addition of the refined coal tar materially tends to retain creosote oil in the timber. The addition also makes possible the utilization of the poorer grades of creosote oil, which are coming more and more into use, and that where such oils are used with the coal tar addition, smaller quantities can be used at a probably lower cost than where larger quantities of the same inferior oils are used. Remembering these indications, it is pointed out that the coal tar addition, when properly used, is worthy of trial. Where it is thought desirable to add refined coal tar to creosote oil, it should be observed that

only a low-carbon coal tar should be used, that is, one having a percentage not to exceed 5 or 6 per cent of free carbon.

Before the combination of creosote and coal tar is used for the impregnation of timber, the two substances should be thoroughly mixed in a tank reserved for that purpose, preferably at a temperature of 180 degrees Fahrenheit, and during the process of impregnation the temperature of the mixture in the cylinder should be maintained at least at 180 degrees Fahrenheit.

One of the most important considerations is that if the coal tar is used anywhere, it should be mixed with the creosote oil under the immediate direction of the railroad company, and with their full knowledge. The practice which has come about in various quarters of selling creosote oil mixed with coal tar as a No. 1 specification oil, should be stopped; and the caution is added that the greatest care should be taken, where timber is treated with creosote, where a No. 1 specification is called for, that the specifications for such oil as printed in the Manual, be rigidly enforced.

Conclusions.

It is recommended that the following be adopted by the association and inserted in the Manual:

(1) (b) *The Use of Refined Coal Tar in Creosote Oil.*

(1) Wherever possible only Grade 1 Coal Tar Creosote should be used, and under no circumstances should coal tar be added to creosote of this grade.

(2) Where it is thought advisable by any company to use coal tar in mixture with the lower grades of creosote, i. e., grades 2 and 3 of the American Railway Engineering Association, and poorer, the following precautions should be followed:

- (a) That there be a distinct understanding between all concerned that a mixture is specified and used.
- (b) That the coal tar be added to the creosote only at the plant and under the direct supervision of the railway company.
- (c) That under no circumstances should the coal tar added constitute more than 20 per cent of the mixture.
- (d) That the coal tar and creosote be thoroughly mixed at a temperature of approximately 180 degrees Fahrenheit before being applied to the timber, and that the mixing be done in tanks other than the regular working tanks, and that the tanks containing the mixture shall be heated and agitated thoroughly each time before any oil is transferred to the working tanks.
- (e) That only low-carbon coal tar be used, the amount of free carbon not to exceed 5 per cent.
- (f) That in treating with the mixture, the temperature of the solution in the cylinder be not less than 180 degrees Fahrenheit.

(4) *Methods of Accurately Determining the Absorption of Creosote Oil.*

(1) At railroad plants the absorption should be based on the treatment which will give the most complete penetration for each class or kind of timber, specifying complete penetration of the sapwood and as much of the heart as possible for the particular species or charge; payment to be based on the amount of oil used, plus operating and other charges.

(2) Where railroads have their work done by contract, gallons should be specified for ties, posts, cross-arms and other material of uniform size, and pounds per cubic foot for other material; the same requirements as to sap and heart penetration to be applied as in the above.

Discussion.

W. M. Camp.—It seems to me that these conclusions might be misconstrued.

Herman von Schrenck.—The committee simply recognizes the commercial conditions in giving precautions in the use of coal tar.

J. L. Campbell.—I think we should allow the dilution of No. 1 creosote.

G. B. Shipley.—The amount of first grade creosote has been insufficient to supply the demand for nearly a year.

Herman von Schrenck.—The chief object of adding coal tar is to increase the permanence of the lower grades of creosote and not to increase the volume of the oil.

Conclusions (1) under the use of refined coal tar was adopted, and conclusion (2) was received as information.

Conclusions (1) and (2) under Methods of Accurately Determining the Absorption of Creosote Oil were adopted.

GRADING OF LUMBER—SPECIAL COMMITTEE.

Dr. H. von Schrenck, Chairman; B. A. Wood, Vice-Chairman; W. McC. Bond, D. Fairchild, R. Koehler, A. J. Neafie, W. H. Norris, R. C. Sattley, J. J. Taylor.

The committee reports progress in the formulation of additional grading rules for lumber not yet classified, and advises that the rules adopted in 1913 had met with the approbation of some of the largest associations manufacturing lumber. The members are urged to make general use of the rules already adopted in the purchase of maintenance of way lumber.

WATER SERVICE—COMMITTEE 13.

A. F. Dorley, Chairman; J. L. Campbell, Vice-Chairman; C. C. Cook, R. H. Gaines, W. S. Lacher, E. G. Lane, A. Mordecai, W. A. Parker, W. L. Rohbock, Chas. E. Thomas.

The committee reported progress on the subject "Design and Relative Economy of Track Pans from an Operating Standpoint."

Water Treatment and Result of Study Being Made of Water Softener from an Operating Standpoint.

A formula is published in the Manual for determining the justifiability of water treatment, but it is difficult to assign values in formula since (1) many of the benefits are intangible; (2) the necessary subdivision of locomotive, operation and maintenance cost is not obtained, and (3) the presence of other variables, such as physical conditions, traffic, personnel, equipment and power.

Current Practice in Water Treatment.

Three general methods of water treatment are in use:

- (1) The use of soda ash (sodium carbonate) directly in locomotive tanks.
- (2) The use of some proprietary anti-scaling compound, with or without an anti-foaming ingredient, either in the locomotive tank, or directly in the boiler.
- (3) The treatment of water with soda ash only, in the road tanks, generally with provision, through a float outlet and a sludge valve, for the removal of a portion of the sludge. These "soda ash plants" permit of an accuracy of proportioning impossible with methods (1) and (2).

Abandonment or failure of softening plants, brought to the notice of the committee, are the result of faulty design, operation, or supervision, rather than an inherent fault in the principles of water softening.

(3) General rules for installation and operation of water softeners and use of treated water based on study of water softeners from an operating standpoint.

(A) Design and Installation.

(1) The plant must be of adequate capacity. It is necessary to anticipate possible increases in the consumption of water at the station considered. This may result from increase in volume of traffic, reduction in number of stops for water due to increase in size of engine tanks, or preference for treated water over that at adjoining stations not treated. The prospective plant must be carefully investigated to ascertain if the proportions of all parts are such as to insure the rated capacity. It is not safe to accept a plant requiring a reduction in the time for treatment because of special appliances purported to accelerate the process.

(2) The installation of softening plants must follow a systematic plan. Greater success is generally obtained by com-

pleting the installation on one division first, rather than installing plants at individual points of especially bad water. A softening plant is not completely successful as long as engines served have badly encrusted boilers, and desired improvements in this respect cannot be fully obtained when engines take from other stations water which is high in incrusting matter. This condition, of course, would not obtain in the case of a plant at the single intermediate water station for passenger engines where the water at the terminals was of good quality, or in a plant at a terminal serving a great many switching or transfer engines that receive water from no other source.

(3) The mechanical features of a treating plant must be so simple as not to require expert attendance. Where proportioning is automatic, it is essential that the machine is not easily thrown out of adjustment.

(4) Feasibility of treatment of a given water should be carefully investigated. This applies especially to waters containing large proportions of incrusting sulphates or sulphates in combination with quantities of alkali salts. Treatment of such water by the Porter-Clark process may result in water containing such high proportions of foaming solids as to be entirely unusable.

(B) Operation, Maintenance and Supervision.

(1) Adequate supervision is necessary to successful operation of a softening plant. Such supervision must be exercised



A. F. DORLEY, Chairman
Committee on Water Service.

at least in part by a chemist, or an engineer having adequate knowledge of water treatment. A tendency on the part of operating and mechanical officials to underestimate the importance of treating plants has frequently been evidenced, emphasizing the necessity for supervision on the part of some one who has the interests of the plant at heart.

(2) Provision should be made for frequent analysis of both the treated and raw water. This is necessary, principally as a check on the treatment, and also to some extent on account of changes in the condition of the raw water. This is of more importance with water from streams or surface reservoirs; but even with wells, changes occur occasionally, due to entrance of surface water, or perhaps to failure of supply from one of several water-bearing strata.

In order that the analyses shall be effective, they must be made under the supervision of a competent chemist. Simple tests with soap and acid solutions which are of sufficient accuracy to handle ordinary operating results, should be made at least once a week by the chemist for check purposes.

Where creek or other water subject to sudden changes is

softened, a simple testing outfit, accompanied by specific instructions and chart for each individual water, should be provided for the plant operator, who with little practice and weekly check by the chemist will become sufficiently proficient to make formula changes to meet the variations in character of water.

(3) Proper mechanical operation and maintenance of the treating plants must be provided for through adequate supervision on the part of a supervisor of water service, bridges and buildings, or equivalent officer. Where the division organization is in use, a check on such supervision must be maintained by an engineer directly responsible for the water treatment.

(4) Where the plant is inadequate in size, arrangements should be made to use raw water to such an amount as to permit of proper treatment of all water that passes through the softener.

Use of Treated Water.

One of the objections against softened waters is foaming, due to the presence of sodium salts as a result of treatment for incrusting sulphates, together with alkali salts which may have been present in the raw water. Suspended matter increases the foaming tendency, so one remedy consists of blowing off periodically to prevent concentration of precipitated matter.

Anti-foaming compounds are in general use, but except in extreme conditions, cleaning boilers often, using clean water, and blowing off frequently and periodically, will eliminate foaming.

The report contains also an example illustrating a method for calculation of the economies resulting from the installation of water softeners, and a report showing the economies resulting from the installation of water softeners on a large railway in the middle west. Progress was reported on "Recent Developments of Pumping Machinery."

Conclusion.

Your committee respectfully submits the following conclusion:

The report on Subject (2) is submitted as information only. It is intended to give the association a brief outline of the developments of water-softening on railways since this subject was studied by the Water Service Committee in previous years. Particular reference is given to the relation of the problem of water softening to railway operation.

Discussion.

The report was submitted as information, and there was practically no discussion.

BUILDINGS—COMMITTEE 6.

Maurice Coburn, Chairman; M. R. Long, Vice-Chairman; G. W. Andrews, J. P. Canty, O. P. Chamberlain, D. R. Collin, C. G. Delo, C. H. Fake, C. F. W. Felt, G. H. Gilbert, A. T. Hawk, H. A. Lloyd, P. B. Roberts, W. S. Thompson.

The following statement summarizes some of the important points in the report on Roofing, pp. 839 to 878, Vol. 14 of the Proceedings. For detailed information, reference should be had to that report.

In selecting a roofing there should be considered:

- (1) Chance of leaks, due to character of construction.
- (2) Probable life, including chance of damage by the elements and by wear from other causes.
- (3) Fire-resisting value.
- (4) Cost of maintenance.
- (5) First cost.

The important materials may be classified as follows:

Bituminous substances, applied with felts made of rags, asbestos or jute.

Clay and cement products and slate.

Metals.

They are laid in two general types: That for a flat roof, cemented together, as a coal tar pitch and gravel roof or as an ordinary tin roof; and that for a steep roof, laid shingle-fashion.

Description and the advantages were given of a number of

different types of roofs, including Bituminous Materials, Felts, Built-up Roofs, Ready Roofing, Slate and Tile, Asbestos Shingles, Wood Shingles, Cement Tile and Metal Roofings.

Some valuable matter was presented under the subject "Principles Covering Design of Inbound and Outbound Freight Houses," and "Shop Floors," for publication in the Manual. This information embodies the requirements to be met in the designs.

Conclusions.

Your committee recommends:

(1) That the report on Roofing be adopted and substituted for the matter under that heading now appearing in the Manual.

(2) That the report on Freight House Design be adopted and substituted for the conclusions relating to inbound and outbound freight houses now in the Manual (p. 395).



MAURICE COBURN, Chairman
Committee on Buildings.

(3) That the report on Freight House Floors be approved for publication in the Manual.

Discussion.

The portion on freight houses was adopted with minor modifications.

The chairman stated that the part relating to "Shop Floors" is incomplete, but recommended it be included in the Manual and added to later.

A motion was made and carried to accept the report on Shop Floors as information.

RAIL—COMMITTEE 4.

J. A. Atwood, Chairman; W. C. Cushing, Vice-Chairman; E. B. Ashby, A. S. Baldwin, J. B. Berry, M. L. Byers, Chas. S. Churchill, G. M. Davidson, F. A. Delano, P. H. Dudley, C. H. Ewing, C. F. W. Felt, L. C. Fritch, A. W. Gibbs, A. H. Hogeland, C. W. Huntington, John D. Isaacs, Thos. H. Johnson, Howard G. Kelley, C. F. Loweth, H. B. MacFarland, R. Montfort, C. A. Morse, J. P. Snow, A. W. Thompson, R. Trimble, Geo. W. Vaughan, M. H. Wickhorst.

Standard Rail Sections.

The committee stated that their investigations indicated the inadvisability of railways purchasing rail lighter than 80 lb. section, for replacements in main tracks on districts which have class A or class B traffic. No definite conclusions have been reached as to a change in the standard rail sections, nor as to sections heavier than 100 lbs. per yard.

Statistics of Rail Failures.

Failures in rail bases are few in the thick base sections, such as A. R. A., type "B." The effect of mill practice cannot be determined accurately, due to lack of required information, as reported on the association's forms 408 and 411. The latter have been revised, and combined into form 408, and the information obtained on this blank is expected to lead to definite results.

Special Investigations.

An investigation was made at the works of the Bethlehem Steel Co. on the influence of draft in rolling the ingot into a bloom, particularly on transverse ductility of the base, and on seams. These results are not complete, but indicate poorer results in drop and transverse tests of rail base.

A comparison was made of acid open hearth steel, with rails



J. A. ATWOOD, Chairman
Committee on Rail.

of basic open hearth steel. No great difference was detected, but the tests were not extensive. Tests on rails from re-heated blooms showed about the same results as wash-heated blooms.

A report by H. B. MacFarland, engineer of tests, A., T. & S. F. Ry., showed that seams in the base cause decrease in transverse strength and ductility, causing broken bases and broken rails.

An investigation at the works of the Bethlehem Steel Co. showed that cracks on the right and left sides of the ingot as it first entered the blooming rolls resulted in seams in rails, while cracks on top and bottom did not.

The influence of aluminum, added in the molds when pouring, was investigated at the plant of the Illinois Steel Co., and showed that a more uniform composition was obtained.

The committee now feels safe in classifying the causes of rail failures under the following heads:

- (1) Crushed and split heads;
- (2) Broken rails (square and angular breaks);
- (3) Broken bases (crescent breaks);
- (4) Transverse fissures (oval spots in rail head).

The causes for (1) are segregation, an excessive concentration of carbon and phosphorus in the interior and upper part of the ingot, which can be avoided by using well deoxidized, quiet setting steel, and by discarding ingots with "horny" tops. Seams, caused as described in the investigation mentioned above, are responsible for (3) and for a large percentage of (2). These failures include about 90%, and definite causes cannot yet be assigned for (4). We have little information on the subject of cracked webs.

Rail Joints.

A general inquiry was made as to proper spacing of bolt holes, and showed considerable variation and opposition to changing standards. A uniform spacing is submitted of $5\frac{1}{2}$ inches, center to center of holes, for both four and six-hole angle bars.

Some changes were suggested in specifications for rolling carbon steel rails.

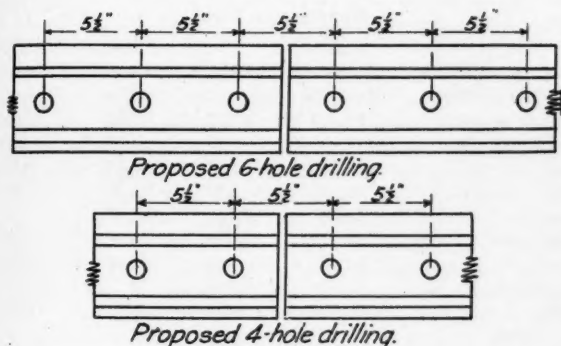
Conclusions.

The committee recommended (1) the adoption of the specification revisions for adoption in the Manual; (2) the adoption of the new form 408, "Statement of Rail Failures," for substitution in the Manual in place of forms 406 and 411.

Discussion.

The chairman stated that sufficient information had not been collected to decide as to the efficiency of the A. R. A. sections, but that the thick base section had practically eliminated base failures.

J. L. Campbell suggested that the committee investigate the feasibility of having a uniform width of base on several rail



Angle Bar Drilling.

sections, to facilitate relaying with heavier steel.

W. H. Courtney suggested intensive investigation of transverse fissures, which cause failures without warning or indication. These fissures seem to appear only in rails of heavier section rolled in recent years.

The chairman stated that this subject is under investigation by a joint committee, and that the solution seems near.

TIES—COMMITTEE II.

L. A. Downs, Chairman; G. W. Merrell, Vice-Chairman; A. M. Acheson, C. C. Albright, H. W. Brown, W. J. Burton, S. B. Clement, E. D. Jackson, H. C. Landon, F. R. Layng, E. R. Lewis, R. J. Parker, J. G. Shillinger, G. D. Swingly, D. W. Thrower, H. S. Wilgus, Louis Yager, E. C. Young.

The Effect of the Design of Tie Plates and Spikes on the

Durability of Ties.

A general inquiry was sent out, from which the following conclusions were made:

(a) Plates with deep ribs or claws cut the tie so as to admit moisture and decay. The deep ribs or claws are not necessary to hold the plate in position and are undesirable.

(b) Flat-bottom plates used with cut spikes become loose and the looseness results in mechanical wear of the tie. They are satisfactory when used with screw spikes.

(c) Plates with cross-ribs not over $\frac{3}{16}$ -in. deep or other independent fastenings that will hold them to the tie, do not seriously damage the tie and at the same time do not become loose and cause mechanical wear when used with ordinary cut spikes.

(d) The width of the tie plate is an element to determine the mechanical wear of the tie; plates less than 7 in. wide for use

with softwood ties cut into the tie sufficiently in some cases to determine the life of the tie.

(e) The plates should be of sufficient thickness to avoid cupping on either side of rail. This thickness depends on the projection beyond the rail, the amount of traffic, the kind of tie and the rate of deterioration from rust, etc.

(f) Screw spikes prolong the life of ties over that obtained with cut spikes.

(g) Where treated ties are used, all boring should preferably be done previous to treatment.

(h) Ordinary driven cut spikes, by breaking down the structure of the wood for an inch or so around the spike, facilitate decay at that point where greatest strength of the tie is required. In the case of treated ties, this introduction of decay below the treatment may defeat the purpose of treatment.

(i) The breaking down of the structure of the wood, with the use of cut spikes, is, to a considerable extent, avoided where the spike is driven in a bored hole. Spikes so driven have at least the same holding power as spikes driven without boring.



L. A. DOWNS, Chairman
Committee on Ties.

Where spike holes are to be bored and cut spikes used, the diamond-pointed cut spike is preferable, because of the greater ease with which it follows the hole.

Economy in Labor and Material Resulting from the Use of Treated Ties.

Answers to a circular inquiry addressed to members of the association indicates that the average life of untreated ties is 7.78 years, cost \$0.761; the average life of treated ties is 13.85 years, cost \$1.031.

Information has been obtained that indicates \$0.23 is an average charge for labor for a tie renewal. There is an additional, undetermined cost due to disturbance of roadbed.

The investigation indicates the economy of ties treated with a preservative of the proper quantity and quality to preserve the tie against decay to the limit of mechanical wear.

The scarcity of timber, the possibility of using inferior timbers, and the decrease in cost of tie renewals in a term of years are considerations which favor the use of treated ties.

There is a growing realization of the necessity of adzing and boring ties before treating, and of boring the holes clear through the tie to promote drainage and thus increase the life of the tie.

Use of Metal, Composite and Concrete Ties.

Under this subject information is being collected from year to year of different types of ties installed on steam or electric

railways. Information was obtained from about 23 railways as to the service being rendered by a number of composite, or metal ties.

Appendix A—Holding Power of Different Kinds of Spikes.

A large number of tests were made by H. B. MacFarland, engineer of tests, A., T. & S. F. Ry., to determine the holding power of different types of spikes:

No.	Point	Length Inches.	Spike Length Inches.	End Inches.	Size of Spike Inches.
1	Chisel...	1.1	5.80	0.05 by 0.55	0.57 by 0.56
2	Chisel...	1.1	5.75	0.05 by 0.55	0.57 by 0.57
3	Sharp...	1.1	5.70	0.06 Square	0.57 by 0.57
4	Sharp...	1.0	5.75	0.07 Square	0.57 by 0.56
5	Blunt...	0.5	5.35	0.25 Square	0.58 by 0.56
6	Blunt...	0.5	5.30	0.25 Square	0.58 by 0.56
7	Blunt...	0.8	5.60	0.25 Square	0.58 by 0.57
8	Blunt...	0.8	5.40	0.25 Square	0.57 by 0.57
9	Blunt...	1.25	5.35	0.25 Square	0.57 by 0.58
10	Blunt...	1.15	5.45	0.25 Square	0.58 by 0.57
11	Blunt...	1.70	5.30	0.25 Square	0.57 by 0.57
12	Blunt...	1.60	5.45	0.25 Square	0.57 by 0.57

Discussion.

The average values for all pulls made from $\frac{3}{8}$ by 4-in. bored holes in all pine, red and white oak ties treated, show the following order:

Spike Designation		Pounds	
Number.	Point.	Start.	Pull.
3 & 4	1-in. sharp	5,300	3,590
7 & 8	$\frac{3}{4}$ -in. blunt	5,160	3,700
11 & 12	$1\frac{1}{4}$ -in. blunt	5,110	3,080
5 & 6	$\frac{1}{2}$ -in. blunt	5,020	3,615
9 & 10	$1\frac{1}{4}$ -in. blunt	5,010	3,040
1 & 2	1-in. chisel	4,590	2,920

And the following order for tons holding power per ton of metal:

		Pounds	
		Start.	Pull.
3 & 4	1-in. sharp	9,510	6,440
11 & 12	$1\frac{1}{4}$ -in. blunt	9,400	5,670
9 & 10	$1\frac{1}{4}$ -in. blunt	8,870	5,370
7 & 8	$\frac{3}{4}$ -in. blunt	8,700	6,310
5 & 6	$\frac{1}{2}$ -in. blunt	8,450	6,060
1 & 2	1-in. chisel	8,020	5,110

The columns headed "start" show the initial force required to overcome all resistances and start the spike, while those headed "pull" show the average resistance of each spike after it has been started and is being drawn from the hole.

In both of the above tables the spikes are ranked upon their relative resistance to the initial pull or start. The ranking order of the different spikes based upon the average resistance after the initial start, however, would be slightly different, but is consistent in that it shows the chisel-pointed spike inferior to all the others tested.

These data shows that the holding power of the 1-in. chisel-pointed spike is but 86.7 per cent that of the 1-in. sharp Goldie pointed spike, and from 1 to 10 per cent below that of the special blunt-pointed spikes tested.

The injury to the fiber of the wood is maximum with the chisel-pointed spike and a minimum with the sharp-pointed spike.

It is also greatly diminished with the blunt-pointed spikes.

The chisel-pointed spike is harder to drive straight than the others, where tie plates are not used.

There is little apparent difference in holding power of the four forms of blunt-pointed spikes tested. The pull required to start the different spikes varied less than 3 per cent.

Conclusions.

1. The Goldie spike is superior to the chisel-pointed spike not only in holding power, but on account of better alignment in the hole.

2. Better holding power and less tendency to break down the wood fiber are obtained with spikes inserted in bored holes.

Appendix B—Holding Power of Cut and Screw Spikes.

The investigation on this subject was also made by Mr. H. B. MacFarland. The common spikes used were $\frac{3}{8}$ -in. cut spike, weighing $9\frac{1}{2}$ ounces. The screw spikes were $\frac{3}{8}$ -in. rolled V-thread, with $\frac{1}{2}$ -in. pitch, and with a diameter of $\frac{3}{8}$ -in. at bottom. They weighed 19 ounces. One-half the spikes were pulled at once, and the other half were pulled 6 months later, after being exposed to weather conditions.

The results show a holding power for screw spikes of about $2\frac{1}{2}$ times the holding power of the ordinary spike, while its weight is 2 times that of the ordinary spike.

A compression test was made by inserting squared sections of ties in the testing machine, and noting the load necessary to sink a rail $3/16$ -in. in the tie, and then applying and noting the load necessary to sink the rail $\frac{3}{8}$ -in. in the tie. The following table shows the results obtained:

Compression Test.

Kind of Wood.	Pounds		Pounds	
	to sink rail	per sq. in.	to sink rail	per sq. in.
Shortleaf pine	39,050	1,225	47,190	1,480
Longleaf pine	27,405	860	34,560*	1,082
Douglas fir	30,880	968	34,440	1,080
New Mexico pine...	26,060	816	31,160	977
Balsam	23,560	739	27,560	863
Red gum	34,640	1,088	42,120	1,320
Red oak	41,670	1,306	53,350	1,670
Japanese oak	63,860	2,000	80,700	2,530
Ohia	76,720	2,400	88,710	2,780

*Indicates tie split.

Red gum, balsam, longleaf pine and red oak fibres were not broken by the compression test, indicating very elastic fibre. Japanese oak and ohia showed a slight breaking of the fibre, and Douglas fir, shortleaf pine and New Mexico pine had very brittle fibres.

Appendix C—Effect of Design of Track Spikes and Tie Plates on the Durability of Ties.

A number of illustrations were shown which give evidence of the damage done to fibres in the ties by driving the spikes in the ordinary manner, which would seem to be an unanswerable argument in favor of boring the ties before putting them in track.

Other photographic reproductions were shown which illustrate vividly the rapid mechanical destruction of ties not plated, as compared with ties having tie plates. Mechanical damage from rail cutting and ties slewing was illustrated by photographs of track without tie plates or rail anchors.

On some screw spike track on the Missouri division, A., T. & S. F. Ry., there has been a movement of rail of only $2\frac{1}{2}$ in. in five years. Track with screw spikes at centers and quarters showed a movement of 4 in. in a year, which would seem to favor solid screw spike track. A derailed train ran 18 rail lengths on the ties of screw spike track on the western division, A., T. & S. F. Ry., trimming tie plates, spikes and joints, but the gage of track was not impaired, and only one tie was taken out of track.

Views were also shown of the Betts combined anti creeper and tie plate, with 6-in. plates on 7-in. ties, these views indicating the advisability of using 7-in. plates.

Illustrations were also shown indicating the damage caused by the old style, deep-ribbed Wolhaupter tie plate. These show splitting and rotting of the wood under and adjacent to the tie plate seat.

In view of the damage to ties by reason of cleaning locomotive fires on tracks, committee suggests the installation of a number of steel ties painted white, at each end of passing track, so that they could be easily seen by an engineer, and then issue orders compelling engineer to pull up to that point before cleaning out firebox.

Discussion.

Robert Trimble—We have been having considerable difficulty with screw spikes coming loose, and are inclined to favor the cut spike, although final results have not been obtained.

L. A. Downs—The same difficulty was experienced on the A., T. & S. F. Ry. at first, but experience has shown the remedy and demonstrated the merits of the screw spike.

W. M. Camp—I wish to emphasize the fact that comparisons between screw and drive spikes are unfair, unless holes are bored for the drive spikes.

C. E. Lindsay—I think that greater attention should be paid to the horizontal thrust, in tests comparing holding power of spikes. We have made experiments with a serrated tooth spike which showed from 2,290 to 3,700 lbs. necessary to draw it. The force necessary to move it horizontally was 4,179 to 4,920 lbs. We have also experimented with a truncated spike, to reduce throat cutting. The resistance of the latter was about as follows:

	Lbs. to withdraw.	Lbs. to move horizontally.
Truncated spike	2,290 to 3,090	4,470 to 5,740
Ordinary spike	2,610 to 3,850	4,670 to 5,750

Our observations lead me to think that the greater weight should be given to the horizontal thrust.

G. J. Ray—Our screw spike track has been very satisfactory—screw spikes show at least twice the pulling as well as lateral resistance of the ordinary spike. We use flat plates with our screw spikes, and experience no particular difficulties, and we have absolutely no indication that screw spikes will not be entirely satisfactory. Rail has been relayed three or four times on some of our 5 or 6 deg. curves, and the screw spikes have not given a great deal in that time, and no regaging has been necessary. With only three or four screw spikes to the rail, however, we have trouble where track heaves; the cut spikes don't hold and the heads of the screw spikes break off.

W. B. Storey—With flat plates and screw spikes, in soft ties, plates rattle, due to their sinking into the tie. We have experiments under way on 20 miles of double track, under heavy traffic. We also have some single track with part screw spikes, but have not yet obtained definite results from our experiments.

G. J. Ray—The only trouble we have ever experienced has been due to brine drippings, which occasionally corrode the heads of screw spikes so that the wrenches will not take hold. We had a derailment which took out all the cut spikes, but only about one out of twenty of the screw spikes, and the latter held the track so the wrecker could operate without delay.

W. B. Storey—We are using one 3/16-in. rib on our plates, which prevents lateral but not vertical movement. This rib is not deep enough to cut the tie, but merely compresses it.

SIGNS, FENCES, AND CROSSINGS—COMMITTEE NO. IX.

C. H. Stein, Chairman; G. E. Boyd, Vice-Chairman; R. B. Abbott, H. E. Billman, E. T. Brown, B. M. Cheney, A. C. Copland, F. N. Crowell, Arthur Crumpton, J. T. Frame, L. E. Haislip, C. M. James, Maro Johnson, L. C. Lawton, J. B. Myers, G. L. Moore, C. H. Splitstone, J. A. Stocker, W. F. Strouse, W. D. Williams.

Investigation of Ways and Means for Securing a Proper Quality of Fence Wire.

A circular was prepared by the committee and mailed out to the various railways represented in the Association, but the

replies gave no definite results which add to previous reports. Due to the fact that investigations are only starting on this subject, it would be well to discontinue it for a few years, and then take it up again.

Signs.

A circular of inquiry was sent out requesting blueprints and information as to laws, decrees, or court rulings regarding the lettering on signs.

Only three railways reported using standard road crossing signs of metal, with metal posts, the others using wood. Concrete has been used in one case for both sign and post, and in another for the post only.

The objects to be achieved in a crossing sign are reasonable cost, economy in maintenance, which include durability, and proper and ample warning of the existence of a railway crossing.

The committee, after a study of the information obtained, presents a design of sign which, in its opinion, most adequately meets these conditions. It should be made with wooden blades



C. H. STEIN, Chairman
Committee on Signs, Fences and Crossings.

12 in. wide and 8 ft. long, with mitred ends placed in a diagonal manner with an angle of 50 degrees between blades on an 8-in. by 8-in. by 16-ft. wooden post. The post should stand 4 ft. in the ground, and be creosoted from bottom to 6 in. above ground line. The lower 9 ft. of post should be painted black, and the balance white. The blades should be painted white with black letters, and 1/2-in. black border around blades. Border and lettering should be on both sides. Letters should be Egyptian style, 9 in. high, with the exception of connecting terms, as "for the" in the recommended sign, which should be 4 in. high.

The committee also made an investigation of trespass signs, and laws governing same in different states.

The committee, after a study of the information obtained, presents a form of sign which would seem to most nearly conform to what is required in the way of reasonable first cost, durability, neatness and legibility. The wording on same might conform to the judgment of the management of each particular road, where statutory regulations do not provide for the form of wording.

These signs should be made of cast-iron 1/4-in. in thickness, borders to be raised 1/8-in., with slight draught; they should be 1 ft. 6 in. deep by 2 ft. 6 in. wide, with 3/8-in. diagonal cast ribs on back for stiffness; all signs to have face of letters and borders painted black on white background; posts and back of signs to be painted black, letters to be raised 1/4-in. with slight draught; 2 1/2-in. wrought-iron pipe, or good second-hand boiler tubes filled with grout to be used for posts. When

concrete or stone foundations are not used, the pipe is to be planted 3 ft. 6 in. deep in the ground and a 1-in. diameter gas pipe about 18 in. long should be run through the pipe post about 1 ft. below ground line to keep it from turning. The wording indicated on typical signs presented, "RAILROAD PROPERTY—TRESPASSING FORBIDDEN UNDER PENALTY OF LAW," or "DANGER—DO NOT TRESPASS ON THE RAILROAD," is suggested.

Concrete and Metal as Compared with Wood for Fence Posts.

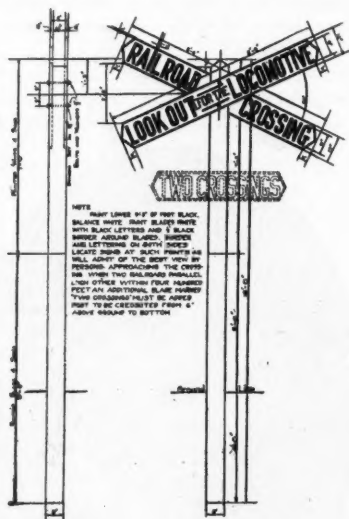
The subject of concrete posts is being investigated. Tests have been arranged for at the Lewis Institute, Chicago, which will be financed and supervised by the Universal Portland Cement Co., and from these tests data will be obtained on the

for grade separation between steam railway street railway and community.

CONSERVATION OF NATURAL RESOURCES—COMMITTEE 19.

William McNab, chairman; C. H. Fisk, vice-chairman; R. H. Ashton, Moses Burpee, F. F. Busteld, A. W. Carpenter, G. A. Mountain, W. L. Park, G. H. Webb, R. C. Young.

A progress report was submitted in which the committee outlined the work which was being done by the National Conservation Congress, in which the committee is represented. The principal subjects treated at the last meeting of this congress were "Water Power" and "Forestry." The railways



Adopted Standard Crossing Sign (Wording Not Standard).

actual strength of posts of various design under different conditions.

Conclusion.

The committee recommends:

- (1) The adoption of the specifications and plan of a highway crossing sign.
- (2) The adoption of the specifications and plan for a public trespass sign. (Appendices A and B give laws relating to signs and trespassing in various states.)

Discussion.

C. E. Lindsay—I think we should give the crossing sign more investigation and see if we cannot adopt a type that will be more visible and striking. I would suggest a sign reaching clear across the road, and move that this sign and specifications be referred back to the committee.

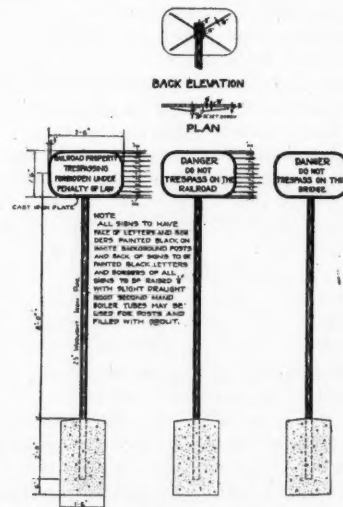
The discussion on the type of signal was taken up by several members, and the point made that where especially necessary a visible and audible signal could be installed, that the crossing sign submitted by the committee could be used as a standard, and that it is more economical than others suggested. The question as to the exact wording was brought up and the chairman stated that the wording was not specified.

The motion to accept the crossing sign as recommended was carried.

Motions were made to eliminate reference to creosoting of the post of the trespass sign, and to add to the specifications "inscription must conform to local requirements."

An amendment was offered and passed to eliminate reference to concrete poles. The specifications and diagram of the trespass sign were then accepted.

A suggestion was made by B. H. Mann that the committee go into the subject of galvanizing for fence wires again; Hunter McDonald suggested a study of the apportionment of costs



Adopted Standard Trespass Sign (Wording Not Standard).

are not directly interested in water power, except (1) the railways contemplate electrification or (2) the revenues of the railways are decreased by developing electric power by water and thus decreasing the coal consumption and the coal traffic.

In Canada the tendency is noted towards substitution of oil for coal, as locomotive fuel. The Canadian Pacific Ry. has created a department of natural resources under the direction of a competent engineer. This department is interested in seeing that every acre of its lines produces a full complement of the products for which the soil is best fitted.

The increase in timber preservation is a feature tending toward conservation.

The report was received as information.

ECONOMICS OF RAILWAY LOCATION—COMMITTEE 16.

R. N. Begien, chairman; C. P. Howard, vice-chairman; F. H. Alfred, A. C. Dennis, F. W. Green, L. C. Hartley, P. M. LaBach, J. deN. Macomb, C. W. P. Ramsey, A. K. Shurtleff, F. W. Smith, H. J. Simmons, E. C. Schmidt, John G. Sullivan, Walter Loring Webb, M. A. Zook.

The committee continued the work reported on in 1913, but had no further results to present. A recommendation was made that three men be employed permanently, as the work of the committee involved the analysis of a vast amount of figures and the drawing of many profiles, maps, etc.

The report was accepted as a progress report, without discussion.

RECORDS AND ACCOUNTS—COMMITTEE 11.

W. A. Christian, Chairman; M. C. Byers, Vice-Chairman; W. S. Danes, G. J. Graves, G. D. Hill, Henry Lehn, J. H. Milburn, O. K. Morgan, Frank Ringer, Guy Scott.

Some changes were suggested in the Manual, form M. W.

1101 to be taken out, due to duplication, other revisions being of minor importance.

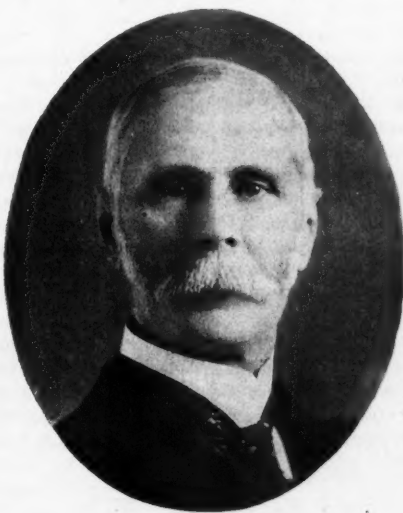
The committee advocated discontinuing the subject of forms for accounts, due to the fact that the Interstate Commerce Commission and American Railway Association have made up rules governing this subject.

The committee recommended changes in the conventional signs or symbols as printed in the manual, to make them as complete and consistent as possible. The I. C. C. has specified as many of these as applicable, and the changes recommended are to harmonize with the I. C. C. rules.

Economical Management of Store Supplies.

The committee recommended that details of classification should conform to that of the Railway Storekeepers' Association; (2) the detailed methods of keeping accounts as reported in 1913 is fundamental, but can be varied to suit requirements; (3) store should be located at point of greatest consumption and the force should be under the supervision of the maintenance department.

Other information relative to classifications of the I. C. C. are given in detail, as affecting maintenance account.



WM. McNAB, Chairman
Committee on Conservation of Natural Resources.

Reports Required by Federal and State Railway Commissions.

After studying blank forms received from the different states the committee, while reporting progress, desires to withhold the report and calls for an expression of views on the subject.

Valuation.

A complete reproduction of the conventional signs adopted by the Interstate Commerce Commission was included, as applying to topographical, right of way, track and structural plans. The specifications were also reprinted in full (all contained in Bulletin 164, A. R. E. A.).

Discussion.

The point was made that curves should be shown by dotted lines on profiles to prevent the confusion caused by using a curved line.

J. B. Jenkins—I would suggest brown instead of blue for relief lines, as former will reproduce on photographs. I move the symbols as corrected be adopted and printed in the Manual.

The motion carried and the conclusions under "Economical Handling of Supplies" was accepted as information.

UNIFORM GENERAL CONTRACT FORMS—SPECIAL COMMITTEE.

W. G. Atwood, chairman; C. A. Wilson, vice-chairman; C. Frank Allen, John P. Congdon, Thos. Earle, J. C. Irwin, R. G.

Kenly, E. H. Lee, C. A. Paquette, H. C. Phillips, J. H. Roach, H. A. Woods.

A few minor changes are suggested in the contract form adopted last year. The form of "Construction Bond" has not yet been completed, and it is recommended that the form be furnished to the secretary when completed, and that he send it to the senior officer of each railway represented in the Association, for criticism and suggestions.

After some discussion the suggestions were adopted.

BALLAST—COMMITTEE 2.

H. E. Hale, chairman; J. M. Meade, vice-chairman; L. W. Baldwin, D. P. Beach, W. J. Bergen, A. F. Blaess, T. C. Burpee, O. H. Crittenden, F. T. Darrow, J. M. Egan, T. W. Fatherson, H. L. Gordon, G. H. Harris, C. C. Hill, S. A. Jordan, William McNab, A. S. More, J. V. Neubert, S. B. Rice, E. V. Smith, F. J. Stimson, S. N. Williams.

Ballast Sections, with Particular Reference to the Use of Sub and Top Ballast.

The committee obtained a large number of ballast sections which were presented in Appendix A, but are not reproduced



WM. G. ATWOOD, Chairman
Committee on Uniform General Contract Forms.

herewith. The ballast section as recommended is reproduced herewith. The specifications are: (a) In class A stone ballast section, the top shall consist of broken stone and, where economical, there shall be a sub-ballast of fine material, such as cinders or gravel, or granulated slag.

(b) The depth of ballast shall be 24 in. and on curves the depth of 24 in. shall be maintained under the low rail.

(c) Where top and sub-ballast is used, the thickness of the top or coarser ballast shall be 12 in. and the thickness of the sub-ballast, or finer material, shall be 12 in.

(d) The slope of the ballast on the side shall be 2 to 1, and the upper corner shall be rounded off with a 4-ft. radius.

(e) The top of the ballast shall slope with a grade of $\frac{1}{2}$ -in. to 1 ft. from a point in the center of the track at the top of the tie to the intersection with the 4-ft. radius above-mentioned, to avoid interference with track circuit.

(f) In a general way the proposed plan of the Baltimore & Ohio Railroad should be followed.

(g) The top of the sub-grade shall not be level, but shall be raised in the center to provide drainage.

(An appendix to this report contains a valuable article on "Cleaning Stone Ballast by Means of Screens," written by W. I. Trench, division engineer, B. & O. R. R.)

Discussion.

Objection was made that the recommended ballast section calls for too great a depth of ballast.

J. B. Jenkins—We have 3-ft. depth in some places and 2 ft. is not too much.

L. C. Fitch—The committee is working along the right lines, but I think we should go slow with recommendations.

C. S. Churchill—The great depth of ballast mentioned by some is possibly due to a considerable thickness of cheap sub-ballast.

Hunter McDonald—I think the committee should investigate different kinds of limestone. Some stones form a cement, which prevents good drainage.

The report was accepted as information.

Election of Officers.

The election of officers resulted as follows:

President—W. B. Storey (V.-P. A., T. & S. F. Ry.).

Vice-President—Robert Trimble (Chf. Engr. M. W. Pennsylvania Lines West).

Second Vice-President—A. S. Baldwin (Chf. Engr. I. C. R. R.).

Secretary—E. H. Fritch.

Treasurer—G. H. Bremner (Asst. Dist. Engr. division of Valuation, I. C. C.).

SPECIFICATIONS FOR SCALES.

By M. H. Starr, Chief Scale Inspector, Kansas City Grain Dealers' Association.

The report submitted by Mr. A. M. VanAuken to the American Railway Bridge and Building Association on "Track Scales," contains much that the writer has often wished to see in print, and after reading this, it seems surprising that it has not appeared in some of our engineering publications. For although it is noted that the majority report of the committee was to harmonize this with specifications of the American Railway Association, it would seem that, considering the undeveloped state of specifications for heavy duty weighing machinery, the publication of the more significant parts of this report might

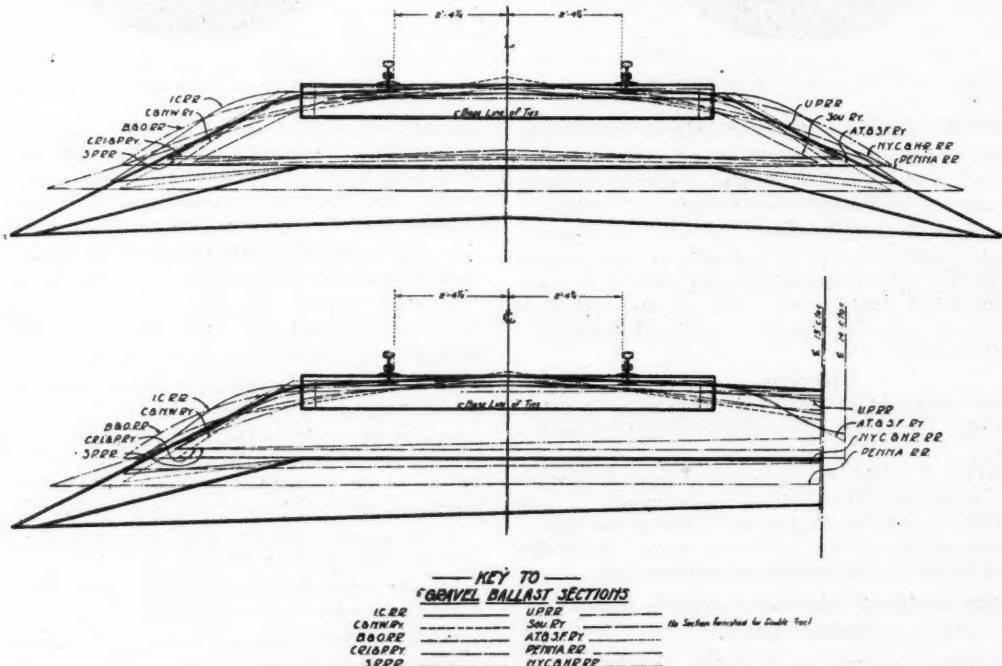
promote an exceedingly profitable discussion on the subject of track scales.

The historical part of this report gives us a little different viewpoint of the development of the art, than literature heretofore printed, the surprising feature, of course, being that a subject of such evident importance should have been the field for so little intelligent research. The fact is that attention has been directed and invited to the manufacturer, and all efforts being concentrated in selling what was offered, the resulting condition is only a natural result of commercialism.

The bill before the House, calling for specifications to be devised by the American Railway Association, would indicate that this body is the best qualified for that important work. The specifications we now have are based upon our present knowledge, but it is the writer's opinion that our knowledge of the proper requisites for heavy duty weighing machinery, is not sufficient for specifications to be evolved which are not open to revision. It would seem



H. E. HALE, Chairman
Committee on Ballast.



Ballast Sections for Single and Double Track.

that the investigations being conducted independently by the different railways, if approached with the same degree of thoroughness that has characterized the evolution of our standard bridge specifications, will develop much valuable data.

This department of our Association has considered for some time the advisability of what is to be known as Association Specifications, covering not only track scale requirements, but all heavy duty weighing machinery, with specific attention, of course, to scales used in our field. We have gotten these out in wagon and hopper scales, but these are not the best specifications possible by a long ways, for if those that we should like to get out were followed strictly, there would be no scale available for installation, as at present manufactured.

One thing, it seems, would be very advisable, considering our present isolated systems of scale inspection; i. e., that as many properties as possible be marked plainly on the several parts of the scales, such as fulcrum distance, long arm, power arm, weight of fractional poise, total weight of poise, etc., so that these could be checked directly and independently without a cumbersome elimination test made necessary by the less than capacity amount of test weights used.

About the line of tolerance, which is the allowable variation between the true weight and the weight indicated by scale; I do not believe a statement of tolerance as a unit figure defines the true tolerance. This department of our Association has its tolerances, but in each case the tolerance is connected with the contributing errors. For instance, we may find under a test of a hundred thousand capacity hopper scale, that the variation is less than the least graduation on the scale beam, or the total weight involved in the test. However, that is not the end of the story. In every case we locate the contributing errors, to find whether they should not be corrected. A hopper scale of large capacity, with hoppers so designed from the bin conditions that the ratio of the height to the base is large, may be set with its center of gravity at a distance from the vertical neutral axis, without load. When load is introduced in the hopper this distance is usually increased, but after the full amount of load is applied to the hopper, the error caused by this condition is weighed in or balanced. Unless an amount of test weights is used equal to the amount of the applied load, this error cannot be read directly, but must be computed. On the usual amount of test weights used, this error may lie within the least graduation of the scale beam, but if such an error were allowed to continue, it would certainly fall without the tolerance, and should be corrected. On the other hand, an error showing the same amount due to, say, stretch of beam rod, falling within the tolerance, would be negligible. Almost without exception, an error read on the beam is a collective error, and unless the tolerance is set very small, on a capacity load, it would seem wise to include as a part of the test when made with less than capacity load, checking methods upon the various parts of the scale, to show that, within allowable limits, those conditions which obtain when the scale is balanced without load are maintained unchanged when under load.

In other words, means should be taken to analyze the error. We have found in our field that the greatest fault of the ordinary scale inspector is his lack of knowledge in analyzing the error which appears on the beam, and failing thereby to correct the contributing errors. In this connection, with reference to the contribution to Mr. VanAuken's report, by Eugene Motchman, page 99, in the first paragraph, in which he says, "To test a traffic scale can better be done by the engineer than by the inspector who travels with test car"—this is absolutely true, unless the test car man himself has engineering qualifications.

Our Department, through the exigencies of circumstances, has developed methods of testing scales with various loadings and a small amount of test weights, but while in our work the amount of error is important as a matter of record, and may be developed in almost every case having to do with shipping scales, it would seem that the amount of error in track scales tested would be only incidental in showing the condition of the weighing machine. Granting this, it would seem that an unusual amount of weights

is not required, if in connection with the known quantity of weights a sufficient load be intelligently used, as the seal of a scale can be checked with an ordinary amount of weights as a rule, while the change in relation of the members can be developed with a load of sufficient quantity. It would seem, however, that if such a method were to be followed, it would require one to conduct the test who was capable of drawing correct conclusions from the data developed. It has been the writer's privilege on some occasions to witness tests made with test car and load, by railway test car inspectors, which produced results that to the test car men were much like the giraffe to the farmer, who, at his first sight of this curiosity, as will be remembered, remarked to his wife, "There ain't no such animal." One incident in particular is recalled, where a loaded car was used in connection with test car placing these two in various relations to each other, in one case having test car at one extreme end of the scale with front truck of loaded car on the other extreme end, this producing one result. Changing to an opposite relation, practically the same result was obtained. Moving the loaded car at a greater or less distance on the scale, and placing the test car to the various other sections, produced again other results, these loads producing, of course, the various phenomena of the continuous girder; and the test car man used up most of his strength and all of his temper pinching the test car and moving nose irons, trying to make the proper adjustment for these changing conditions, finally using the test car alone. After some hours of work the scale was adjusted to this weight. It is the writer's opinion that surprising results would be obtained by some railroads if they applied exhaustive tests to the track scales and drew correct conclusions from these results, and considering the Interstate Commerce Commission's report on the subject these surprising results would not be hard to get, either.

Another instance may be cited in support of Mr. Motchman's statement. A new installation in our territory was refused certificate by this Department on account of design, shortly after test and examination were made by a railroad expert, who recommended some minor changes in the setting of scale, but failed utterly to locate the real error. Bringing the matter to an issue, the manufacturers recognized as correct the stand of this Department and made the necessary changes without much protest.

We may some day have infallible weighing machinery universally, but until that time ordinary hammer and saw carpenters, retired derrick men, etc., will not produce the best results in the construction, maintenance and intelligent inspection of present day scales.

As stated before, considering the undeveloped state of specifications for heavy duty weighing machinery, it does not seem that we have the proper data at hand to dictate a rigid design for track scales. In other lines of endeavor not nearly so vital as weighing machinery, intelligent research has developed practically all of the solid steps in the stairway to ultimate perfection. But, considering the extent to which weighing machinery is used, where would we turn for text on this subject? We have specifications now covering design of scales which read more like vindications. Only a little experience with scales is necessary to show surprising lack of uniformity in the quality of so-called standard scales. We find one pivot of such a temper that loads applied in cold weather chip out the edge in half-moon shapes, a steel frame construction where carelessness in fabricating allows only one half bearing on pivot, tension bolts in compression side of member, etc., and some levers of the truss type in which the compression and tension members are not lined together at right angles to the plane of supporting pivots, which, under load, cause line of force to fall without the truss. There must be enough people interested, from a disinterested standpoint, to furnish whatever is necessary for intelligent research along the line of scale design, and remove us from a position which we occupy today, which compels us to accept whatever the manufacturers choose to give us.

The method as at present used in handling scale installations is very unsatisfactory. Only in special cases is there one competent superintendent from start to finish, the several different steps of the work being performed by various persons, and, in many cases,

with no knowledge of the essential features to be maintained in the installation. Scale manufacturers only under special stress will furnish an installation complete, it being necessary in practically all cases for one to build the foundation, another to make the scale, and a third to make the frame and assemble the machine. Then, if each has done his work correctly, the scale will weigh. But as for the success of this system for scales in general, it is submitted that the most of the work of our Department consists in undoing work that has been done incorrectly.

We are trying to establish a different form in handling the installing of all weighing machinery; namely, that of taking complete charge of the work from first to last, and delivering the finished product, which is the scale, to the operator. It might be said that with railroads the foundation work will be installed in the best possible manner, they being equipped with a specialized force to do this work. But there are many shipping scales, which come under the different Weighing Association Agreements, which by that agreement are treated in the same manner as railway owned scales, and specifications which are framed for the railway owned scales should of necessity include the Industry Railroad Track Scale.

We have found our system of supervising the entire installation, to be very satisfactory. There may be no good reasons why the scale manufacturer should be further involved, after delivering to the buyer, a weighing machine conforming to accepted specifications. We have found that the most irritating condition along this line is the trouble in fixing the responsibility for inaccurate weighing machinery, the manufacturer laying it on to the builder, and the builder maintaining that the scale was put in according to plans furnished, the buyer of the scale being between the two; and it has been our experience, that where we were allowed full responsibility and the authority to do the best we knew how, that this sought for responsibility has brought no further trouble to our shoulders, but on the contrary, in every case, has insured satisfaction.

As a further suggestion, it might be recommended that the phraseology be standardized to do away with the somewhat obscure terms we now have.

The above remarks are hastily put down, inspired by the reading of Mr. Van Auken's report.

STRUCTURES.

The Atlantic Coast Line will begin work very shortly on the new passenger depot to be built at Thomasville, Ga. The plans have been accepted by the city and the company has called for bids on the work. The station will be a two-story brick structure with all modern conveniences and up-to-date in every particular. It is estimated to cost between \$45,000 and \$50,000.

The Bessemer & Lake Erie has given a contract to Roberts & Schaeffer Co. for a 400-ton reinforced concrete locomotive coaling station at Branchton, Pa.

The Canadian Northern will build a \$300,000 station at Calgary, Alta.

The Chesapeake & Ohio it is said will enlarge shops at Huntington, W. Va.

The Chicago, Milwaukee & St. Paul is planning the construction of a new passenger station at Iron Mountain, Mich., and also a roundhouse and coaling station. The cost will be \$35,000.

The Chicago, Rock Island & Pacific has awarded a contract to the American Bridge Co. for steel for the Seventy-ninth street crossing, Chicago.

The Cleveland Street Railway Co. is to spend \$5,000,000 for 26 new car houses within the next five years, according to plans announced by President J. J. Stanley, of that company.

The Delaware, Lackawanna & Western will spend about \$750,000 on the elimination of grade crossings in Syracuse, N. Y., it is said.

The Dallas Union Terminal Co. has awarded the contract for building the new union station at Dallas, Texas, to James Stewart & Co., of New York.

The Eastern Maine is authorized to construct and operate a bridge, without a draw, across the Penobscot river between

Bangor and Brewer, Me., in a bill recently passed by the House.

It is reported that the Great Northern has made an appropriation of \$16,000 for a new depot at Morris, Minn., and that work will begin as soon as the weather will permit.

The Great Northern, it is said, is in the market for 4,000 tons of bridge material.

The Illinois Central will enlarge its yards at Dubuque, Iowa.

A new \$10,000 concrete bridge will be erected across the Lehigh Canal at Morrisville, Pa., and the N. J. & P. Traction Co., will double-track its road.

The Missouri Pacific has prepared plans for a new brick passenger station at Carthage, Mo., to cost about \$25,000. Work will be started soon.

The New York, New Haven & Hartford has awarded contract to Lewis F. Shoemaker & Co. for 100 tons of steel for two bridges at Groton, Conn.

The passenger station of the New York, New Haven & Hartford at Hartford, Conn., was recently destroyed by fire entailing a loss of between \$250,000 and \$300,000.

The Norfolk Southern has let the contract for a \$21,000 passenger station at Elizabeth City, N. C., a \$15,000 freight depot at Goldsboro, N. C., and a \$3,500 freight and passenger depot at La Grange, N. C.

The Pennsylvania has authorized the reconstruction of the North Philadelphia, Pa., passenger station.

Bids will be asked for soon for track elevation work in South Philadelphia, Pa., for the city and the Pennsylvania.

Bids have been received by C. H. Byers, chief engineer of the Puget Sound & Willapa Harbor railway, a branch of the Milwaukee, for the bridge work necessary between Raymond and the present end of the P. & E.

The Pennsylvania is taking bids on three subways at Morrellville, Pa.

Brown-King Co., Harrison building, have been awarded the contract for a concrete and steel bridge at Mount street, Baltimore, for the Pennsylvania to cost, \$40,000.

The Philadelphia & Reading will build a new station at Pottstown, Pa.

The Southern will spend about \$750,000 on a new classification yard in Memphis, Tenn., it is reported.

The Texas & New Orleans has prepared plans for new wharves, cotton sheds and other terminal facilities at Clinton, Texas.

The Winston-Salem Southbound will build a steel bridge at Linden street, Winston-Salem, N. C., at a cost of about \$30,000.

Plans have been completed for a concrete and steel bridge which the Louisville & Nashville R. R. will erect over the tracks at Washington street, at Winchester, Ky.

The Missouri Pacific will build a freight station at Carthage, Mo., costing \$15,000. It will also enlarge its yards at that point.

The Missouri Pacific has selected a site for a new station at Claremore, Okla., and expects to start work early in the spring.

The Missouri, Kansas & Texas, the St. Louis & San Francisco, and the Missouri, Oklahoma & Gulf are contemplating a new union station at Durant, Okla.

The Missouri, Kansas & Texas will begin construction shortly on the proposed \$1,000,000 depot at San Antonio, Tex.

Thompson-Starrett Co. will build the First National Bank-Soo Line twenty-story building at Minneapolis, Minn. The bank expects to be in the new building, along with the Soo Line's general offices, by February 1, 1915.

The Pennsylvania has placed a contract with the Brown-King Construction Company, Philadelphia, Pa., for a reinforced concrete bridge to be built over the tracks of the Philadelphia, Baltimore & Washington at Mount street, Baltimore, Md. This road, it is said, has plans completed for the erection of a new steel and concrete bridge over the Schuylkill river at Phoenixville, Pa.

The St. Louis & San Francisco has approved plans for the proposed new freight depot at Tulsa, Okla., the main building of which will be 40x330 feet, with an extension open platform 40x200 feet.

CONCRETE DEPARTMENT

The Use of Tables, Diagrams and Other Labor-Saving Devices in Concrete Design

THE very rapid growth of the concrete industry has given rise to the publication of many diagrams, tables and other so-called "labor-saving devices for the use of the engineer, designer and constructor of concrete structures of all kinds. It is only in justice to the authors to say that some of these have been of great value on account of their completeness and because the assumptions upon which they are based, and the actual limitations of their use have been clearly stated. A great number of these devices, however, are not so clearly defined as regards their use, and on account of their apparent simplicity have led to poor and very unsatisfactory designs by inexperienced men, and instead of aiding the industry, have worked toward its disrepute. Until an engineer has thoroughly satisfied himself that the underlying theoretical principles are correct and the limitations of use clearly defined he should hesitate to use tables, diagrams or calculating devices made by others.

The young engineer without experience should especially be warned against such practices, for if not overly energetic he is very likely to fall into the habit of using these "labor-saving" devices whenever the occasion demands, and once in the rut he is sure to remain there, and sooner or later be classed as an unsuccessful engineer.

We do not wish to be cited as being opposed to tables and diagrams for solving engineering problems, for when properly used they are invaluable. However, we do say that every engineer should make up his own tables and diagrams, or carefully check those made by others (except, of course, simple and standard tables which are familiar to all and of widespread use) in order that he be entirely familiar with their proper application. On account of the character of the material, tables and diagrams for reinforced concrete design cannot be as simple and free from restrictions as those for structural steel design, and hence more care must be exercised in their use.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—The cement market has advanced somewhat in certain districts and the prospects are very good for an increase of activities in all lines. Prices given are f. o. b. cars at points named, including cloth sacks, for which, in general 40 cents per barrel (4 sacks) is refunded on return in good condition. Prices per barrel (including 4 cloth sacks) are as follows: Boston, \$1.72; New York, \$1.58; Chicago, \$1.55; Pittsburgh, \$1.50; New Orleans, \$1.64 on dock; Memphis, \$1.82; Cleveland, \$1.63; Detroit, \$1.59; Indianapolis, \$1.63; Toledo, \$1.59; St. Louis, \$1.55; Milwaukee, \$1.59; Minneapolis and St. Paul, \$1.70 to \$1.75; Montreal, \$1.75 to \$1.80; Toronto, \$1.90; Winnipeg, \$2.40 to \$2.50; Kansas City, \$1.63; Omaha, \$1.78; Portland, Ore., \$2.15; Spokane, \$2.30; Seattle, \$2.30; Tacoma, \$2.10; Duluth, \$1.78.

Crushed Stone—1½ in. stone, prices per cubic yard, f. o. b. cars in carload lots, unless otherwise specified. Boston, 80c per ton at the quarry; New York, 95c to \$1.00, in full cargo lots at the docks; Chicago, \$1.15; Toronto, 75c per ton at quarries; Spokane, \$1.25; Seattle, \$1.25; Portland, Ore., \$1.00.

Gravel—Prices given are per cubic yard f. o. b. cars in carload lots unless otherwise noted. Boston, 75c; New York, 95c to \$1.00,

in full cargo lots at docks; Chicago, \$1.15; Portland, Ore., \$1.00; Spokane, \$1.25; Seattle, 75c; Winnipeg, \$1.85; Tacoma, 65c.

Sand—Prices are per cubic yard, f. o. b. cars in carload lots unless otherwise indicated. New York, 50c, full cargo lots at docks; Chicago, \$1.15; Toronto, \$1.15; Portland, Ore., \$1.00; Spokane, \$1.00; Seattle, 75c; Winnipeg, \$1.75; Tacoma, 65c.

Reinforcing Bars—The demand is increasing but the prices in general are about the same as those given last month. Pittsburgh base quotations on mill shipments f. o. b. cars, are from \$1.20 per cwt., with the prevailing extras on bars under ¾ inch or base. The following are quotations on base bars per 100 lbs., for mill shipments from other points, f. o. b. cars: New York, \$1.31; Philadelphia, \$1.35; Chicago, \$1.38; Portland, Ore., \$2.10; Spokane, \$2.70; Seattle, \$2.20; Tacoma, \$1.90.

Shipments from stock are being made at the following prices per cwt. f. o. b. cars: Pittsburgh, \$1.70; New York, \$1.90; Cleveland, \$1.75; Cincinnati, \$1.75; Chicago, \$1.85; Montreal, \$2.15; Toronto, \$2.25; Winnipeg, \$2.50; Portland, Ore., \$2.40; Spokane, —; Tacoma, \$2.05; Seattle, \$2.25.

Metal Clips for Supporting Bars—\$7.25 to \$8.00 per 1,000, depending on size.

For the majority of the prices given we are indebted to the Universal Portland Cement Co., Concrete Steel Co., American Sand & Gravel Co., Chicago, and F. T. Crowe & Co., of Seattle, Portland, Spokane and Tacoma.

Reinforcing bars for mill shipments are in general sold on a Pittsburgh basis; that is, at the Pittsburgh quotation plus the freight to the point in question, and with the following list of freight rates on finished material and the Pittsburgh quotation given, the price of bars at any of the points listed can be readily computed.

From Pittsburgh, carloads, per 100 pounds to:

Albany	16 cents	Columbus	12 cents
New York	16 cents	Cincinnati	15 cents
Philadelphia	15 cents	Louisville	18 cents
Baltimore	14½ cents	Chicago	18 cents
Boston	18 cents	Richmond	20 cents
Buffalo	11 cents	Denver	84½ cents
Norfolk	20 cents	St. Louis	22½ cents
Cleveland	10 cents	New Orleans	30 cents
Birmingham	45 cents		

CONCRETE ARCH BRIDGES.

The following conclusions drawn in a paper, "Concrete Bridges; Some Important Features of Their Design," by Walter M. Smith, Sr., and Walter M. Smith, Jr., in Vol. 39, p. 1193, Proceedings of the American Society of Civil Engineers, are of interest. This paper deals with the advantages of an arch of two ribs over the solid soffit arch, with narrow ribs rather than wide ribs and with deep ribs of I-section rather than rectangular section; it also deals with the advantages of the three-hinged arch over the fixed and two-hinged types.

The writers believe that the following conclusions are amply justified by the investigations:

- (1) An arch span consisting of two separate ribs is more economical than one with a solid soffit, if the span is greater than 100 ft.
- (2) Narrow, deep ribs are more economical than thin, wide ones.
- (3) The three-hinged arch is more economical and reliable than fixed or two-hinged arches for spans greater than 100 ft.
- (4) For spans of 200 ft. or more the rib of I-section is more economical than the rectangular rib.
- (5) Piers of any considerable height are much more economical if built of two separate legs thoroughly braced, thickening rapidly in the direction of the axis of the bridge as they go down.

MASONRY—REPORT, A. R. E. A.

G. H. Tinker, chairman; F. L. Thompson, vice-chairman; R. Armour, Richard L. Humphrey, J. C. Beye, J. H. Prior, C. W. Boynton, F. E. Schall, W. A. Clark, G. H. Scribner, Jr., T. L. Condron, A. N. Talbot, J. K. Conner, Frank Taylor, G. W. Hegel, Job Tuthill, L. J. Hotchkiss, J. J. Yates, committee.

No revision of the Manual was recommended.

Final report on waterproofing of masonry (Appendix A) was presented and the conclusions were adopted and are to be published in the Manual.

The report on the Disintegration on Concrete was presented and the conclusions were adopted and their publication in the Manual recommended.

The Joint Committee on Concrete and Reinforced Concrete will endeavor to round out its report to represent the best American practice.



G. H. TINKER, Chairman
Committee on Masonry.

Next Year's Work.

It was recommended that the subject of "Principles of Design of Plain and Reinforced Retaining Walls, Abutments and Trestles" be continued and a further effort be made to obtain some data upon the pressure of earth upon retaining walls.

It was also recommended that the Specifications for Plain and Reinforced Concrete Masonry be revised.

APPENDIX A.

Waterproofing Masonry and Bridge Floors.

In compliance with the instructions of the Board of Direction, the committee made further investigation of the subject of Waterproofing Masonry and Bridge Floors, and the following is an abstract of the report.

Masonry construction should usually be impervious to water in order that it may be protected from possible disintegration. The presence of water within masonry structures not designed to retain water is objectionable.

The outline given below includes the ordinary methods of waterproofing:

(I) Coatings.

- (1) Linseed oil paints and varnishes.
- (2) Bituminous:
 - Asphalt.
 - Coal Tar.
- (3) Liquid hydrocarbons.
- (4) Miscellaneous compounds.
- (5) Cement mortar.

(II) Membranes.

Felts and burlaps in combination with various cementing compounds.

(III) Integrals.

- (1) Inert fillers.
- (2) Active fillers.

(IV) Watertight concrete construction.

General Description of Various Methods of Waterproofing and Their Application.

Walls above grade are waterproofed by coating with paints, varnishes or waterproofing washes or by plastering with cement mortar, applied either on the inside or outside of wall.

The walls of basements and pits are waterproofed, either by the application of coatings, membranes, integral or watertight concrete construction. Membranes are usually protected with concrete, brick or bituminous binder.

Where basement or pit walls and floors are below the ground water level, they must be so designed as to resist the existing hydrostatic head in order to prevent cracks and leakage. Either the integral method of waterproofing or watertight concrete construction. If the exterior waterproofing is employed, the membrane is generally used.

Stone, brick or concrete arches, retaining walls, abutments, subway walls and culverts are waterproofed by any of the methods mentioned above. For important structures, the membrane method is most generally used.

When surface coatings, integral waterproofing or watertight concrete construction is used, particular attention must be paid to reinforce the work against cracks due to expansion, contraction or settlement. The expansion joints must be waterproofed by sheet copper or lead built into the adjoining sections.

The solid floors of steel and reinforced concrete bridges probably present the most difficult problems of waterproofing. In steel troughs or I-beam floors a concrete filling may be used to bring the deck up level with or above the top of the steel in the floor. The membrane method is usually used for such structures.

Tunnels in which the ground water level is below the invert may be waterproofed by any of the aforementioned methods.

Subaqueous tunnels present a different and distinct problem of waterproofing; usually reinforced concrete or plain concrete with iron or steel lining is used. The structures are designed to resist the hydrostatic head.

Any of the four methods can be used in waterproofing the walls and floors of reservoirs.

(I) Coatings.

(1) Linseed Oil Paints and Varnishes.

Linseed oil paints are reactive to atmospheric conditions and in alkaline water. Applied as a damp-proofing to the surface of a concrete wall which may be permeable to moisture; the paint is likely to be of short life, unless the surface is specially prepared.

To secure the best results the wall must be dry and clean before application. The coating power is approximately 200 sq. ft. of wall per gallon and the cost varies from \$1.00 to \$3.00 per gallon.

(2) Bituminous Coatings.

This class includes asphalt, petroleum residuum, coal tar and coal tar pitch. As used for waterproofing purposes, they are solid at ordinary temperatures and are therefore often applied while hot. As they are soluble in benzine and coal tar naphtha, they are frequently mixed with these solvents and applied in a liquid form. Two coats cost about one cent for material and one-fourth cent for labor, per sq. ft.

Asphalt.

Bituminous coatings applied cold by dissolving in naphtha, instead of hot, do not set instantly, therefore are much easier to apply. All walls that are to be waterproofed must first be allowed to dry.

Asphalt coatings cost about 65 cents per gallon for material and 0.3 cent for labor per sq. ft., a gallon covering about 100 sq. ft. per coat.

Asphalt Mastic.

Various results have been obtained by the use of asphalt mastic, and it is probable that much is dependent upon the quality of the mastic.

Asphalt mastics are usually applied in layers not exceeding $\frac{5}{8}$ in. in thickness, usually two coats are applied, breaking joints not less than 1 ft. The cost of $1\frac{1}{4}$ in. mastic is about \$30 for material per net ton, a ton covering about 375 sq. ft.; the cost of labor is about 2 to 5 cents per sq. ft., depending on location and conditions.

Coal Tar and Coal Tar Pitch.

Tar produced by the distillation of bituminous coal is used in waterproofing, either applied cold as a paint by dissolving in naphtha or benzine or applied hot. It is also mixed with sand, gravel or screenings to form a mastic. See A. R. E. A. Bulletin 131, Report of Committee on Buildings, for information on coal tar.

Coal Tar Paint.

Annapolis mixture is a coal tar paint composed of one part kerosene oil, four parts Portland cement and sixteen parts refined coal tar. Applied with a paint brush it not only covers the surface but sinks into and bonds with it so that two or three coats are sometimes required. It adheres to moist or even wet concrete. The cost for three coats is $\frac{1}{2}$ cent for material and $\frac{1}{2}$ cent for labor per sq. ft.

(3) Liquid Hydrocarbons—Paraffin and Petroleum.

Waterproofing by the application for a coating of melted paraffin has been used on masonry in much the same manner as hot asphalt. It is also applied cold as a paint made by dissolving the paraffin with naphtha.

Petroleum oil is sometimes applied to the surface of masonry as waterproofing.

The efficiency of these materials depends upon their absorption into the surface of the masonry. Applied to clean, dry surfaces of porous masonry they are fairly efficient.

(4) Miscellaneous Compounds—Soap Washes.

Solutions of soap applied as a wash for waterproofing are not recommended.

Soap and Alum Washes.

Waterproofing by alternate washes of soap and alum is one of the oldest methods and has given fair results when properly used on surfaces sufficiently dense and impermeable to afford support for the void-filling material. Inferior materials and workmanship cannot be atoned for by the use of alum and soap washes. The alum and soap combine and form an insoluble non-absorptive compound in the pores of the masonry surface. The cost of applying two coats each of soap and alum is about $\frac{1}{2}$ cent per sq. ft.

(5) Cement Mortar.

Waterproofing by the application of cement plaster has proved efficient when properly applied.

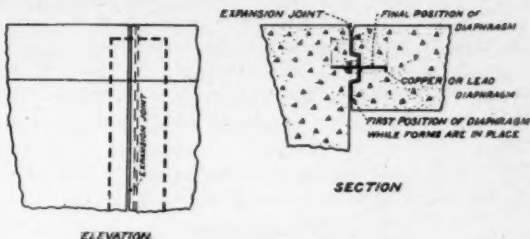
The surface must be clean to insure bond between plaster and masonry and the surface must be kept wet until it has absorbed water to its full capacity.

A wash of neat cement mixed to the consistency of cream, not over 45 minutes old should then be brushed on. The plaster should be applied over the wash before the latter has commenced to dry.

The sand should be well graded from fine to coarse, the maximum size passing a No. 8 sieve. Cement and sand should be mixed 1:1 $\frac{1}{2}$. The mortar should be applied in $\frac{3}{4}$ in. layers if more than one coat is used, each coat being put on before the other has set. Good workmanship is essential to produce a dense impermeable coating. The cost of a $\frac{3}{4}$ in. plaster will be about 6 cents per sq. ft.

(II) Membranes.

Membrane waterproofing consists of the formation of a mat or covering of waterproofing material over the surface to be waterproofed, made up of a number of layers of membrane united by a cementing material.



Waterproofing for Expansion Joint.

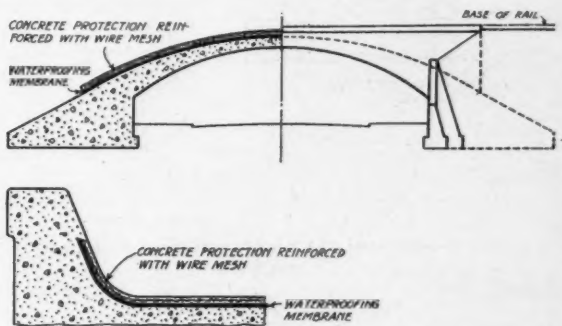
Being somewhat elastic and independent of the movement of the surface, this method offers a protection from the seepage of water through expansion or contraction joints and cracks in the masonry which cannot be secured in any other way.

Materials.

The materials of membrane waterproofing and the combinations which have been most successfully used by the railroads are:

Felts and Burlaps.

Wool felt impregnated with either asphalt or coal tar pitch; the same with a skin coated with the same material, or reinforced with a thickness of cotton drilling cemented to the felt with coal tar pitch.



Method of Waterproofing Arches.

Asbestos felt impregnated with asphalt.

Burlap both plain and impregnated with either coal tar pitch or asphalt.

Cementing Materials.

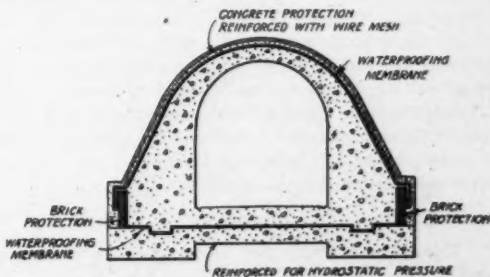
Mined or lake asphalts; petroleum asphalts, coal tar pitch.

Combinations.

Two to three layers of felt cemented together are generally used where no provision for a head of water is necessary.

Four to six layers of felt cemented together are generally used for railroad bridge floors, arches, tunnels, subways and for a protection from a head of water.

It is not desirable to bond the waterproofing to the surface in the vicinity of expansion joints. Special provision should be made for movement.



Method of Waterproofing Subways.

Protection.

The three methods of protecting membranes from injury most commonly used are: (1) brick coverings; (2) two-inch cement coat reinforced with wire mesh; (3) a 1½-in. bituminous binder.

Typical specifications for five-ply waterproofing are given in the report.

The cost of membrane waterproofing varies greatly with conditions and ranges from 20 to 45 cents per sq. ft.

(III) Integrals.

The use of some material in small quantities mixed with the concrete materials in order to make the concrete watertight is generally called the integral method of waterproofing.

1. Inert Fillers.

The addition of a small amount of fine material to a rich concrete with well-graded aggregate decreases the strength. For leaner mixtures the impermeability is increased without decreasing the strength. (See Appendix B.)

The cost of concrete is increased by the addition of such mate-

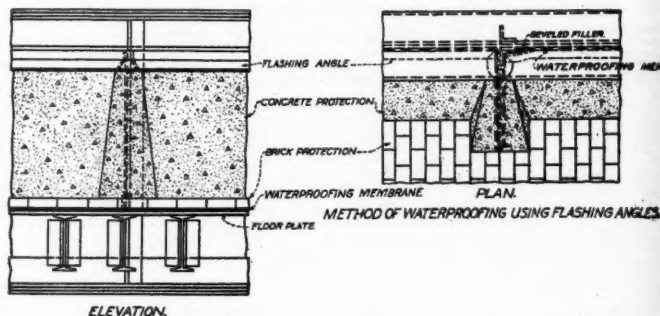
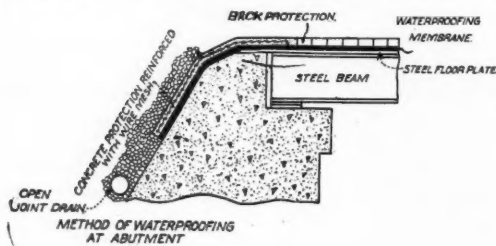
aggregates to secure the filling of voids and employing proper workmanship and close supervision.

(2) Membrane waterproofing, of either asphalt or pure coal-tar pitch in connection with felts and burlaps, with proper number of layers, good materials, workmanship and working conditions is recommended as good practice for waterproofing masonry, concrete and bridge floors.

(3) Permanent and direct drainage of bridge floors is essential to secure good results in waterproofing.

(4) Integral methods of waterproofing concrete have given good results. Special care is required to properly proportion the concrete, mix thoroughly and deposit properly so as to have the void-filling compounds do the required duty; if this is neglected, this value of the compounds is lost and their waterproofing effect destroyed. Careful tests should be made to ascertain the proper proportions and effectiveness of such compounds.

Integral compounds should be used with caution, ascertaining their chemical action on the concrete as well as their effect on its strength; as a general rule, integral compounds are not recommended, since the same results as to watertightness can be



Waterproofing for I-Beam Bridges.

rials from 80 cents to \$1.20 per cubic yard for dry compounds and from 50 cents to \$1 for the liquid compounds, per cubic yard of concrete.

2. Active Fillers.

Compounds which are added to the concrete mixture and which react with certain of the constituents of the cement to form other compounds which will be inert and fill the voids are included in this class. These materials are soaps and saponifiable oils. (See Appendix B.)

(IV) Watertight Concrete Construction.

The results of laboratory experiments supplemented by many examples from practice, have shown that watertight concrete can be made without the use of coatings, membranes or integral compounds.

The question of watertight concrete is then a problem of reducing the size and number of voids by the proper proportioning of the concrete materials. Watertightness is of no avail where cracks occur in the structure and provision should be made in design of watertight concrete structures for primary stresses which are sure to develop. (See Appendix B.)

Drainage.

The first requisite in designing any structure when water is to be kept out from the interior or from beneath, is to provide means of getting rid of the water as directly and quickly as possible. Methods of providing drainage differ with the class of structure. Various methods of drainage are given in the report.

The accompanying diagrams show the methods of waterproofing various structures as given in the report.

Conclusions.

(1) Watertight concrete may be obtained by proper design, reinforcing the concrete against cracks due to expansion and contraction, using the proper proportions of cement and graded

obtained by adding a small percentage of cement and properly grading the aggregate.

(5) Surface coatings, such as cement mortar, asphalt or bituminous mastic, if properly applied to masonry reinforced against cracks produced by settlement, expansion and contraction, may be successfully used for waterproofing arches, abutments, retaining walls, reservoirs and similar structures; for important work under high pressure of water these cannot be recommended for all conditions.

(6) Surface brush coatings, such as oil paints and varnishes, are not considered reliable or lasting for waterproofing of masonry.

APPENDIX B.

(1) Coatings.

Linseed Oil Paints and Varnishes.

Information taken from Technologic Paper No. 3, U. S. Bureau of Standards and from Vol 10, Am. Soc. for Testing Materials, is given regarding the properties and characteristics of these paints.

Asphalt.

Information taken from "Roads and Pavements" by I. O. Baker, and other sources, is given regarding the composition of the various grades of asphalt, viz.: Trinidad, Bermudez and Solid California Asphalt. Data regarding the proper fluxing agents for the harder asphalts in order to soften them, are also given.

The asphalt specifications of the C. & N. W. Ry. and also those for waterproofing the Chicago River tunnels are quoted. Information concerning the use of asphalt for waterproofing has been published in the A. R. E. A. Proceedings in Vol. 11, Part 2; Vol. 12, Part 1; Vol. 13 and Bulletin 64, June 1905.

Quotations from a paper on the Chicago River Tunnels by Wm. Artingstall, Vol 16, No. 19, Jour. W. S. E., give the methods of waterproofing the Van Buren St., Washington St., and La Salle St. tunnels.

Waterproofing with Coal Tar.

References to the use of Coal Tar and Tar Paint are cited from Vol. 12, Part 1; Vol. 13 and Vol 11, Part 2. A. R. E. A.

Soap and Alum Washes.

References—Vol 11, 12 and 13 A. R. E. A. and Baker's Masonry Construction.

Miscellaneous Coatings.

An abstract from Technologic Paper No. 3, U. S. Bureau of Standards, deals with a waterproofing compound composed of 85% iron and 3½% sal ammoniac. It is said that this compound should have considerable value as a waterproofing material.

Cement Mortar.

Reports on use of plaster coatings are published in the A. R. E. A. Proceedings Vol 11, Part 2 and Vol 13.

(III) Integral Methods of Waterproofing.

Inert Fillers.

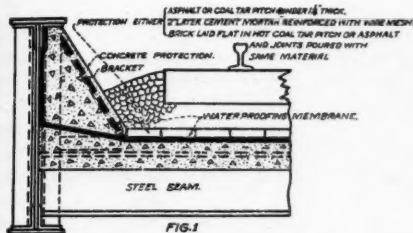
The conclusions drawn by Sanford E. Thompson in a paper,

in colloidal properties. The conclusions drawn are: (1) Clay added to ordinary concrete gives beneficial results in permeability and strength with no practical effect in density; (2) compared with equal excess of cement by weight, clay gives no advantage of practical importance in permeability or density and results in a loss of strength; (3) if the use of clay is practicable on a working scale, its possible economic use under two methods is evident; (a) By mixing with the cement at the mill, it could be sold about 20 per cent cheaper than ordinary cement. (b) By mixing in field in localities where the cost of cement is high and clay can be obtained cheaply.

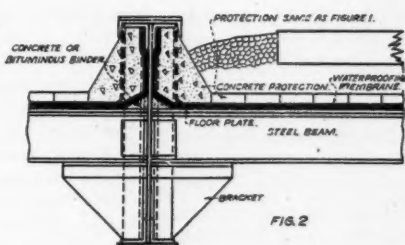
Notes regarding the use of silica and tufa cements and slaked lime are given.

Integral Compounds.

The conclusions as to the effects of oils used in cement and concrete as shown by tests made by the Office of Public Roads, Dept. of Agriculture, are given. This subject matter, taken from Bulletin No. 46, was given in the Feb., 1913, issue of *Railway Engineering*, pages 81 and 82.

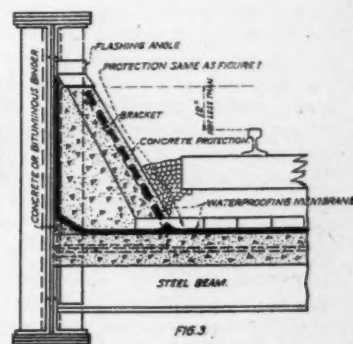


METHOD OF WATERPROOFING FLOORS WITH LOW GIRDERS.



METHOD OF WATERPROOFING FLOORS WITH LOW GIRDERS.

Waterproofing for Girder Bridges.



METHOD OF WATERPROOFING FLOORS WITH HIGH GIRDERS.

"Permeability tests of concrete, with the addition of hydrated lime," are cited as follows:

- (1) Hydrated lime increases the watertightness of concrete.
- (2) The effective proportions of hydrated lime for watertight concrete are as follows:

For 1:2:4 concrete add 8 per cent hydrated lime.

For 1:2½:4½ concrete add 12 per cent hydrated lime.

For 1:3:5 concrete add 16 per cent hydrated lime.

These percentages are based on the weight of dry hydrated lime to the weight of the dry Portland cement.

(3) The cost of large waterproof concrete structures frequently may be reduced by employing leaner proportions of concrete with hydrated lime admixtures and small structures, such as tanks, may be made more watertight.

(4) Lime paste made from a given weight of hydrated lime occupies about 2½ times the bulk of Portland cement paste and is therefore very efficient in void filling.

Tests made by James L. Davis, when in charge of the laboratory of the New York City Board of Water Supply, afford an excellent means of judging the advisability of using inert materials to obtain unpermeable concrete.

The following conclusions are drawn:

(1) Hydrated lime is effective in producing impervious concrete, but its use is of doubtful economy, except, possibly, for resisting low pressure of water.

(2) It is probable that it is not an economical material for structures subjected to tensile stress.

(3) Except, possibly, for low pressures, equally good results in impermeability can be obtained by the same cost invested in additional cement with resulting stronger concrete.

(4) The addition of lime increases the plasticity resulting in smoother surfaces against forms.

Tests similar to those on hydrated lime were made with a white pure clay from Georgia, intended to represent high-grade material

Water-repelling Compounds.

Information regarding stearates of lime or soda and potash is taken from Technologic Paper No. 3.

Alum and Soap.

The alum is mixed with the cement in the form of a fine powder, and the soap is dissolved in the water used in mixing concrete, or both the alum and soap may be dissolved in the water. The effect of the addition of these materials is generally to increase the impermeability and decrease strength.

The use of integral compounds has been reported in the A. R. E. A. Proceedings in Vols. 11 and 13. From Technologic Paper No. 3 we learn that: Portland cement mortar and concrete can be made practically watertight or impermeable to any hydrostatic head up to 40 ft. without the use of any so-called "integral" waterproofing materials; but care should be exercised to obtain a dense mixture.

The addition of so-called "integral" waterproofing compounds will not compensate for lean mixtures, nor for poor materials, nor for poor workmanship. Since in practice the inert integral compounds are added in such small quantities, they have very little or no effect on the permeability of the concrete. If the same care be taken in making the concrete impermeable without the addition of waterproofing materials as is ordinarily taken when waterproofing materials are added, an impermeable concrete can be obtained.

The damp-proofing tests as conducted would indicate that Portland cement mortars can be made not only impermeable but damp-proof without the use of damp-proofing compounds.

The permeability of Portland cement mortars and concretes rapidly decrease with age.

(IV) Watertight Concrete.

Reports concerning the use of concrete without waterproofing in locations where impermeability is required are found in Vols.

11, 12 and 13 of the A. R. E. A. Proceedings. Other references cited and abstracted are from Engineering News Dec. 14, 1911, Am. Soc. for Testing Materials, Vols. 8, 9 and 10. These abstracts and references all point to the facts, that with the proper materials, proper proportioning and handling of the subsequent mixtures, these need no addition of foreign substances to become initially waterproof.

APPENDIX C.

Disintegration of Concrete and Corrosion of Reinforcing Metal.

The subject of the disintegration of concrete, when investigated with the object of preparing a report that shall be of value to engineers, leads directly to the study of the causes of disintegration and the means whereby it may be prevented. The corrosion of the reinforcing metal confines investigation to a study of reinforced concrete. Inasmuch as corrosion of the reinforcing metal ultimately leads to disruption of the surrounding concrete and ordinarily presupposes disintegration of the concrete, the subjects are closely allied.

It is to be noted that in work where extraordinary provisions are made for peculiar conditions, the requirements of good design and engineering in general, covering both materials and methods, must be none the less rigidly adhered to.

Failure to provide for shrinkage of concrete due to hardening in air, and for expansion and contraction due to temperature changes, is a common cause of cracks which are sometimes ascribed to disintegration.

The use of crushed stone screenings as fine aggregate is a frequent cause of disintegration and resultant corrosion of reinforcement.

Concrete in Sea Water.

Investigations concerning the effect of sea water on concrete immersed for periods up to fifty years or more, have been made in European countries and in America.

Regarding the chemical composition of the cement the following conclusions are presented:

Cement containing up to $2\frac{1}{2}$ per cent of $S O_2$ resists the action of sea water fully as well as cement with lower $S O_2$ content.

While all the hydraulic cements now in use are liable to decomposition in sea water, Portland cement is the one to be preferred in every respect.

High iron Portland cement and puzzolan cement have failed to show superiority over standard Portland cement in resisting the disintegrating effect of sea water.

Regarding the effect of varying the proportion of cement in the mortar and concrete, in general, the richer mixtures have been found to offer better resistance to the attack of sea water.

Concerning the addition of finely ground material to the cement after burning, it has been found that the addition of puzzolana to Portland cement increases the resistance of the resulting mortar or concrete to the disintegrating effect of sea water.

No results of practical working tests have demonstrated that the effect of any material in reducing permeability is other than mechanical.

Allowing the concrete to harden under favorable conditions before exposure to sea water greatly increases its resistance to attack by sea water.

When concrete is deposited under sea water, such precaution should be taken as will prevent the washing of the cement from the concrete.

Forms for under sea water concrete should be tight so that a smooth dense surface may be obtained.

The combined effect of freezing and of sea water on marine structures is particularly severe in its disintegrating effects.

Dense, properly hardened concrete is not affected by the action of sea water. The making of a dense, impermeable concrete by the use of a well graded aggregate, rich mixture, proper consistency, and good workmanship, and allowing the concrete to harden under favorable conditions before exposing it to action of sea water is generally conceded to be an efficient means of satisfactorily insuring the preservation of concrete in maritime works.

Concrete Subjected to the Action of Water Containing Alkalies.

Investigations concerning the effect of ground waters which contain alkalies, on concrete, have disclosed several instances of apparent disintegration.

The measures to be used in making concrete which is to be exposed to the action of these deteriorating agencies in order to prevent disintegration are the same as recommended for sea water construction.

Miscellaneous Causes of Disintegration.

Cinders give unsatisfactory results in concrete, especially if there is much coke or porous matter present. Such cinders may be improved if allowed to weather, with occasional washing until the ferrous iron and sulphur have been oxidized and leached out.

Cinder concrete in roofing slabs exposed to the action of locomotive gases is not an efficient protection for reinforcing metal, which has been found to corrode and cause the disintegration of the slab.

Freshly made concrete surfaces in contact with smoke gases at temperatures below 45 degrees F. have failed to harden properly, and experiments indicate that under such conditions the cement is acted upon by the gases. It has therefore been recommended that when heating is done by means of open fires higher temperatures be maintained.

Effect of Electric Currents.

Laboratory experiments furnish most of the information which exists concerning the effect of electric currents on concrete and reinforcing metal. The discrepancy between the conditions in these experiments and field conditions seems to be greater than is the case in other laboratory tests on structural materials, and the information obtained up to this time is difficult of application to field conditions.

It has not been shown that plain concrete is affected by the passage of an electric current through it.

Corrosion of Reinforcing Metal.

Tests and experience have proved that steel embedded in dense concrete will not corrode when located either above or below fresh or salt water level. Concrete in order to be an efficient protection to steel must be rich in cement and mixed to such a consistency as to flow around and completely coat the reinforcing metal.

Steel to be imbedded in concrete should not be painted.

Conclusions.

(1) Concrete exposed to the action of sea water or in contact with alkali waters, or exposed to gases containing sulphur, or in which reinforcing metal is imbedded, should be dense, rich in Portland cement and allowed to harden under favorable conditions before exposure.

(2) Concrete in contact with alkali waters should be made with aggregates inert to the alkalies in the water.

(3) Cinders should not be used in concrete in which reinforcing metal is embedded.

(4) Reinforcing metal should not be painted, but should be thoroughly covered and protected with concrete when in place.

ENGINEERING DESIGN OF FORMS FOR CONCRETE.

R. J. Roark.

The design of forms for concrete structures is a subject which, in the past, has been more a matter of judgment and experience on the part of the foreman in charge, than of engineering design. Very careful designs for the finished structures have been worked out in many cases, while the forms and centering received very little attention. Such neglect has led to serious accidents during construction, while at other times it has led to the use of forms far more elaborate and costly than were required, resulting in loss on a job which should have afforded a profit.

In looking over cost data on various concrete structures, one finds that the cost of forms per cubic yard of concrete varies greatly. For concrete retaining walls the amount of

form surface per yard of concrete is very large, the cost of forms, including labor and material, ranging from 25 to 40 per cent. of the cost of the concrete per yard, depending on the type of wall and kind of forms.

With these facts in mind, it seems that in the effort to obtain economy in the use of steel and concrete, a great many things have been overlooked in the matter of design and centering which play a most important part in determining the final cost of a concrete or reinforced concrete structure.

In any structure, the cost of forms per cubic yard of concrete depends directly upon the ratio of form surface to concrete volume. In a structure where forms can be used but once the cost of forms per square foot of surface exposed to concrete is affected by the following conditions:

(1) If the general design of the structure itself is such as to make possible the use of stock sizes of lumber without undue cutting, ripping or waste, the cost will be materially decreased.

(2) Economy in the use of timber may be secured by carefully designing the forms and centering for the loads coming upon them, and by preparing plans from which the forms may be built with a minimum loss of time and waste of material in the field. By layouts made in the office, a judicious spacing and arrangement of supports and centering can be selected, which will insure a saving of both time and lumber on the job. Forms should be so designed as to allow of erection and removal by methods involving a minimum of wiring, nailing, or labor of any kind. This can only be accomplished by designing them in the office before ordering the material.

(3) The kind of lumber used is another important factor in determining the cost, and depends, of course, on the class of work to be done. Where a good surface is desired, a matched and dressed sheathing should be used, which is free from knots, as the imprint of the knots will show on the surface of the concrete. When such lumber is used the cost of finishing the concrete surface will be less on account of the absence of "lips" and pockets in the surface. White pine is in general too expensive to use except for the very best class of work. Spruce, southern, and Norway pines are the kinds of lumber most generally used. The location of the work and the market conditions must, of course, be taken into account in deciding upon the kind of wood to use.

(4) The labor cost of erection of forms varies greatly, depending on the conditions mentioned above, and also on the wages paid, the organization of the force, and the general layout of the work. At times requirements of clearance, staging, or other matters peculiar to the work in hand, increase or decrease this cost. It might be mentioned that if the work is so arranged that the different gangs do not interfere with each other, the speed of erection will be increased and the cost diminished accordingly.

When the same wood forms are used repeatedly, as on building work, retaining walls, and large bridges, the unit cost of forms per cubic yard of concrete is the result of dividing the total cost of lumber used, plus the erection cost and the cost of taking down and re-erecting the forms a certain number of times, by the total number of yards of concrete placed. From this it can be seen that by a careful selection of unit forms and with a trained organization, the cost of forms, including material and labor, will be considerably reduced.

Besides the conditions mentioned above, the design and general construction of unit forms greatly affect the cost of form work. If a form be so designed as to permit of its being used over and over again without changes involving carpenter work, the cost will be materially reduced, as relatively cheap labor will suffice for the erection. Such

a form should be made very strong and of good material, so as to prevent warping or shrinking under conditions of service, and it should ordinarily be as heavy as the methods and means of erection will permit.

The use of metal forms and centering for arch bridges, culverts and for wall construction, is becoming more and more general. The use of this type of form has opened up a new and promising field in concrete work, and metal bids fair to eliminate timber in certain kinds of construction. Metal forms are especially economical when the structure to be built is large and symmetrical, as they can be used a greater number of times than wood forms, and can also be changed to conform to slight variations in the shape of the structure. Steel is particularly well adapted to use for arch and column forms, and is being used very extensively in these classes of work. The first cost of steel forms is higher than that of wood forms, but the fact that they can be used a far greater number of times often makes them more economical when the unit cost is considered.

MIXING AND PLACING CONCRETE.

By W. F. Strouse, Assistant Engineer, B. & O. R. R.

In arranging for the construction of concrete masonry the first point to receive consideration should be the arrangement of plant for mixing the aggregates and the means of distributing the finished material with the least expenditure of labor. The quantity of concrete to be mixed and placed should of course determine the size and completeness of the plant. For small quantities and where the work is scattered over large areas there are a number of portable mixers on the market which are proving very satisfactory as they can always be placed near the point where the finished material is to be used. For large quantities, whether concentrated or scattered, it is advisable to install a mixer of large capacity and provide bins for the storage of the aggregates.

In the writer's opinion the ideal plant is one where the aggregates can be delivered to the mixer without hand-work, that is, where they can be dumped from the cars, in which shipped, from elevated tracks into bins, from which by the use of chutes they can be delivered into small cars which deliver either directly into the mixer or into a hopper located above it. Such an arrangement, however, is not always possible, or if possible, the expense of installation would not always be justifiable, but there are a number of modifications which are both practicable and economical.

Aside from the economical features of such a plant it permits the prompt releasing of cars and provides for the storage of material, which if properly handled, will prevent delays due to shortage of material.

The writer has in mind a number of plants used on work under his jurisdiction and on work visited, a description of several of which may be of interest, not so much on account of size as of convenience and results. As illustrating a case where work was scattered, attention is directed to the method of constructing the concrete platforms in the large coach cleaning yard of the Washington Terminal Company, Washington, D. C. After the tracks had been laid and ballasted with cinder it was decided to construct concrete platforms 5 feet wide between the tracks, which were spaced 15 ft. centers, the same to be laid on top of the cinders which had been levelled to the top of the ties of the adjacent tracks. As the quantity of concrete per lineal foot was small, considerable thought was given the matter of mixing and placing it at a reasonable cost. After an examination of several portable mixers and considerable study of how to economically distribute the raw and finished materials a "Foote" self-measuring, continuous mixer of sixty yards per day capacity was purchased and fitted up with stand-

ard gauge trucks so it could be moved from place to place on the yard tracks.

The crushed stone and sand were delivered in hopper cars and dragged out on separate tracks, leaving a vacant one between the above mentioned tracks upon which to operate the mixer. Forms consisting of 2-in. x 6-in. planks sat on edge and braced from the adjacent tracks were then set up in the two spaces so formed with partitions at 10-ft. intervals. The tops of the forms were set at the elevation of top of rail which was to be the elevation of top of platform. The partitions were used for the purpose of providing positive joints which would permit resurfacing should the platforms settle or be disturbed in the re-surfacing of tracks. The mixer was then put in operation—men being assigned to shovel stone and sand from the tracks into the respective hoppers, while other men delivered cement from a cement house, centrally located, into the cement hopper. A chute was provided which carried the concrete from the mixer directly into the forms. In placing the concrete every other section only was filled in each line and allowed to set, after which the partitions were removed and the remaining sections filled. This plan was followed throughout the entire yard.

As an inch top finish was desired, the forms were filled to within an inch of the top with the regular concrete and as the mixer was so easily moved along the track, only from four to six sections of forms in each line were usually filled to proper height at a time. The mixer was then moved back and top finish applied by throwing out of gear the sprocket which operated the stone hopper. As fast as the top finish was placed it was worked down by cement finishers. With the above mentioned machine about 15 laborers and 5 cement finishers, from 2,500 to 2,600 square feet of platform were placed per day of 10 hours at a cost of about 12 cents per square foot for a 1-2-4 mixture with regular sidewalk finish.

At another point on the same improvement, where the work consisted of heavy retaining walls aggregating about 50,000 cubic yards of concrete, two rather elaborate mixing plants were installed. The one consisted of a double track trestle 220 feet long and about 25 feet high under which bins for the storage of stone and sand were provided. Under each line of bins a 6-ft. square subway was arranged in which a narrow gauge track was laid upon which to handle material. Adjacent to the outer end of the trestle or that next the mixer was located a cement house. In delivering cement to the house a chute was used between the car door and a trap door in the roof of the house. At a point about 50 ft. beyond the end of the trestle a 5-ft. cubical mixer was installed at a height of about 8 ft. above the ground. A hopper was located above the mixer. The aggregates were carried to this hopper by cars drawn up an incline by cable. The method of operation was as follows: The empty car was first run under the sand bins from which a supply was obtained by opening a door in the bottom of the bin. It was then pushed to the end of the subway where, by a transfer table, it was shifted to the line of stone bins. Stone was then taken in the same manner as the sand. The car was then moved to the end of the trestle at the base of the incline where the cement was added through a small hopper—gauged to proper proportion. The proportions of sand and stone were determined by measurement and indicated by metal strips on the inside of the cars. The car was then drawn up the incline and automatically dumped into the hopper ready to be delivered to the mixer. The concrete was removed from the mixer in two-yard buckets on flat cars drawn by horses or dinkey locomotives and placed in walls by derricks stationed along the same. To facilitate handling the small car under the bins, a light descending grade was introduced in the tracks in the direction of the traffic. With this plant as high as 400 cubic yards were turned out in a day of 10 hours. The number of men required to operate this plant was small, as

practically everything was done by gravity and machinery—except levelling the concrete in the forms.

At another point in the same territory a similar plant was installed except that instead of storage bins a pit 16 ft. wide, 40 ft. long and 11 ft. deep was constructed. Two standard gauge tracks were laid across the pit and extended several hundred feet beyond, one of which was used for stone, the other for sand. Hoppers were constructed under the respective tracks for the delivery of sand and stone. A cement house was located adjacent to the pit. The operation of this plant was as follows: The sand and stone cars were placed on their respective tracks over the pit and material dumped into the hoppers. A specially designed car holding when full, sufficient material for a batch of concrete, was first placed under the stone hopper and the requisite amount of stone allowed to run in. The car was then moved to the sand hopper from which the necessary sand was obtained. The cement was then added by hand. The proper proportion of ingredients was determined by metal strips placed on the sides of the car from actual measurements. Upon receiving the proper proportions of stone, sand and cement, the car was drawn up the incline by cable and automatically dumped into the hopper over the mixer. The capacity of this plant was about 350 cu. yds. per day of 10 hours. The objection to this plant was the lack of storage space—which frequently caused delay in releasing the cars and at other times delayed the work on account of shortage of material.

New Books

COMPRESSED AIR PRACTICE. By Frank Richards. Cloth, 6x9 in. 326 pages, illustrated, numerous diagrams and tables. Published by McGraw-Hill Book Company, New York. Price, \$3.00.

Books on the subject of compressed air are indeed few when one stops to consider the extensive use and application of compressed air to construction work. Not many years ago compressed air was little known or used, while today, within a few decades there is hardly one branch of construction or industrial work in which it is not made use of in some way or other. Coincident with this great increase in its use, has been the accumulation of knowledge regarding the subject in general which warrants the general discussion in text book form. This book is intended for the many rather than the few and is therefore of a general nature, rather than specific. Material of a catalog nature regarding air compressors, and air actuated tools and apparatus is omitted entirely, such information being easily obtained from special publications by the various manufacturers.

The book is composed of twenty-eight chapters the first half of which deal with the principles, methods and devices for producing compressed air, the power derived and the cost thereof, and methods of distribution. This theoretical portion, including many useful tables and diagrams, is treated in a concise and interesting manner such as will appeal to the student and engineer desiring a general knowledge of the subject. The remainder of the book takes up the following subjects, the re-heating of compressed air; compressor and receiver fires; side lines for the air-compressor; gasoline by compression; rock drill developments; the electric air drill, the air left for raising water; air for large steam hammers; the diving bell and caisson; the air jet, sand blast and cement gun; and a discussion on liquid air. The last chapters give one an idea of the vast extent of the uses to which compressed air can be put.

The book is well arranged and made up and contains a wealth of information invaluable to the student and engineer who specializes or deals with, only in general, the field of compressed air. Compressed air is used in nearly all branches of railroad work and nearly every man engaged in railway engineering and maintenance work has more or less to do with air actuated tools. In

order to do the work efficiently he should have a general knowledge of the subject and we know of no better book from which this knowledge can be acquired.

THE EXPRESS SERVICE AND RATES, by W. H. Chandler, assistant manager Traffic Bureau, the Merchants' Association of New York. With appendix of test questions and numerous tables and charts. 340 pages. Published by the La Salle Extension University, Chicago.

Mr. W. H. Chandler, in his treatise on "The Express Service and Rates," presents a work of timely and lively public interest. The vast field of express service has, strange to say, never been adequately treated. Stimson's "Express History" treats of the historical side, but it is now out of date. Various works on transportation devote short chapters to express service, but there has never been an adequate treatment. This fact, even if there were no other reasons for interest in Mr. Chandler's treatise, should make this carefully prepared manual noteworthy.

But there are other reasons. On February 1 of this year the new express rates went into effect. The Interstate Commerce Commission's activity, the parcel post competition, and other events are directing popular interest to this subject. Furthermore, the recent announcement that the United States Express Company is to discontinue brings another reason for popular interest.

It is interesting to note, in this connection, the following concerning the United States Express Company, from the chapter on "Internal Organization of Express Companies" of Mr. Chandler's book:

"The United States Express Company is a joint-stock association or partnership composed of persons associated together to do express business each with full partnership liability for the company's obligations. It was organized April 22, 1854, in the state of New York, for a term of ten years which term has been several times extended.

"At the time of the organization of the United States Express Company the ownership was divided into 5,000 interests. From time to time and down to March, 1876, the number of interests was increased, until at the last mentioned date the ownership was divided into 70,000 interests. During the month of September, 1887, 15,000 interests were sold for \$1,000,000, which sum was at that time paid into the treasury of the company."

The new publication is more a practical than a scholarly effort, though no objection can be brought against it on that score. It covers the whole express field, from history, organization, and service to rates and classification. Express statistics and finance are subjects carefully treated; and both the old and the new rate-making systems are fully explained. This is of especial interest since the rates are lowered considerably. The relation to the parcel post is also carefully discussed.

REINFORCED CONCRETE BRIDGES. By Frederick Rings. Cloth, 8x11 in.; 181 pages, 373 illustrations. Published by D. Van Nostrand Co. Price \$5.00.

A book covering European practice in the design and construction of beam, girder and arch bridges for both highway and railway traffic. It forms a valuable reference work for the American engineer since many of the economic features embodied in European bridges and herein described are entirely too conspicuous by their absence in American bridge design. The author has collected descriptive matter, photographs and data regarding typical structures from many sources.

The reinforced concrete regulations for the county of London found in the introduction refer more strictly to building work but of course apply to bridge design in many particulars. In this connection it is of interest to note that they differ but little from American practice except in minor details. In Chapter 2, on bending moments, stresses and strains all formula are worked out step by step. The next is a very short

chapter on loads on bridges and external stresses. The next two chapters on culverts and smaller coverings, tunnels, etc., and beam bridges are entirely of a descriptive nature with numerous illustrations. Chapter 6 on the calculation of girder bridges is not all that could be desired on account of lack of explanation and some theories regarding shear and double reinforcing of beams, which are not in accordance with the best practice. A descriptive chapter treating of examples of girder bridges contains some interesting information. Chapter 8 on arched bridges is descriptive of details of design and construction, while the chapter following treats of the theory of the arch. Chapter 10, examples of arch bridges, is the best in the book, many British and German structures being described and illustrated with photographs and detail plans. A set of tables such as can be used for the work in hand is included.

The general make-up, typography and illustrations are good and the book should prove useful to the engineer making a special study of concrete bridge design.

THE RAILWAY LIBRARY AND STATISTICS, 1912. Compiled and edited by Slason Thompson. Board, 5x7 in.; 465 pages. Price, 50c. Published by Bureau of Railway News and Statistics, Railway Exchange, Chicago; Ill.

The Railway Library for 1912 is the fourth in the series issued by the Bureau. It contains a selection of noteworthy papers and addresses of 1912, by prominent railway men. Only those subjects are selected which are deemed to be of fundamental importance in railway development.

Railway rates and valuation occupy a prominent place in the volume, and rightly so, as these questions are now of absorbing importance to railway managements.

In one of the speeches quoted from Fairfax Harrison, and dealing with the relations between railway capital and labor, the suggestion is made that the pay of railway employees be made dependent on the operating revenue derived, thus increasing the employees' wages with increased revenue, and decreasing it with decreased revenue.

A number of other papers and articles of direct interest are contained in the volume, which show what phases of the railway situation are considered of paramount importance.

SMALL CONCRETE BRIDGES AND CULVERTS. Prepared by the Information Bureau, Universal Portland Cement Company, Chicago. Paper; 9 x 6 inches; 72 pages; illustrated. Price, 25 cents.

The purpose of this little book is to assist local officials in securing a proper, intelligent and economic design for small bridges and culverts of less than 20 feet span. For structures of larger span the consultation of an engineer is recommended in all cases. For this reason the book is not at all technical, but is made up of valuable suggestions and plans of representative structures, including many standard plans of state highway commissions. These plans are of value for comparisons as to the results of different methods of design for the same types of structures. Besides numerous tables of quantities for various types of structures, useful for estimating, the book contains a short specification for concrete bridge work.

SPECIFICATIONS AND TABLES FOR STEEL-FRAMED STRUCTURES. Second edition, 1913. By the American Bridge Co., of New York. Paper, 5x7½ inches; 70 pages.

Besides the specifications and matter pertaining to the safe loads on beams found in the first edition, this new edition contains plate girder tables covering 16 pages; safe loads, dimensions and weights of H columns, I-beam and plate and angle columns up to 35 ft. in length; details of bases, splices and beam connections; and tables of weights of merchandise and minimum live loads in accordance with various city building laws.

The specifications are notably simple and to the point and should prove invaluable to architects and engineers. The tables

are especially valuable on account of being designed to use only such sections as can readily be obtained from stock or mills, and thus avoid the annoyance so common when this fact is neglected.

A MANUAL OF STANDARD WOOD CONSTRUCTION. Compiled by A. T. North. Fourth Edition. Paper. 4x6 inches. 130 pages. Numerous tables and diagrams. Published by The Yellow Pine Manufacturers' Association. George K. Smith, secretary, Wright building, St. Louis, Mo. Price, \$0.50.

The need of a set of tables pertaining to the strength of structural timbers based on the actual instead of the nominal sizes of the timbers has long been felt by all engineers and architects. The new edition of this work on yellow pine fills this want in a most commendable manner. It is to the lumber industry what the Cambria and Carnegie handbooks are to the steel industry, being compiled along the same lines.

The book contains a short digest of the results of authentic tests; recommended working stresses by various authorities; numerous tables of properties, strength, safe loads and deflections of timber beams, floors, joists and columns; and grading rules for yellow pine lumber.

The aim of the work is to present recommended fibre stresses, based on actual tests, which will do away with tremendous waste of material caused by the very low fibre stresses allowed by some building codes, which the author intimates are prompted by the low stresses recommended by the American Railway Engineering Association and the American Railway Bridge and Building Association for timber bridges.

The book in its present form is very well arranged and compiled, the typography is excellent and the general appearance improved.

Copies of this manual will be furnished gratis to architects, engineers and bridge and building and maintenance of way superintendents, if application is made on letterhead of the railroad company with which they are associated.

STEEL BRIDGE DESIGNING. By Melville B. Wells, C. E. Cloth, 6x9 inches. 260 pages; illustrated; 26 folding plates. Published by Myron C. Clark Publishing Co., Chicago. Price, \$2.50.

A book intended for a text in engineering colleges and as a reference work in drafting rooms and bridge offices. Most books on bridge design give little or nothing regarding the investigation and study of conditions at the site of the bridge necessary to make an intelligent selection of a type of structure to best suit the location; this book, however, is an exception to this rule, discussing, as it does, in a general way this important subject in the first chapter. A more detailed treatment, however, would have made the book more valuable.

A chapter on bridge manufacture, illustrating and describing various tools and their use is interesting and instructive. Chapter 3, on rivets, is followed by a chapter on the design of a roof truss. The methods of calculating stresses are not treated in detail under the design of the various structures, but the derivations of the fundamental formulæ used are given in a later chapter, with examples of their applications, if not referred to in other parts of the book.

Chapter 5 treats of types and details of highway bridges in a general manner, while the succeeding chapter is devoted to the design of a riveted truss highway bridge. A short chapter on types of railway bridges treats of the general types of bridge floors and details. The detail design of a plate girder railroad bridge is given in chapter 8. At the conclusion of this chapter are tables and data on weights of steel bridges. The design of riveted truss and pin connected bridges is treated entirely too briefly, in the opinion of the reviewer, who also questions very much the advisability of omitting, as the author does, much matter on the calculation of stresses in members, and theoretical and economic considerations governing the detail design of various parts of structures. The student or young engineer should be well grounded in the prin-

ciples of design rather than taught to follow parrot-like the one way laid down in a certain text. This danger can best be guarded against by supplementing theoretical consideration with practical examples rather than by separating them.

Chapter 11 treats of general rules and notes on the making of shop drawings for steel structures and although short contains valuable information for the student. Chapter 12, on strength of materials, deals only with fundamental principles and is therefore rather brief. The bibliography which follows is a good selection of articles that have appeared in the technical press. This part of the work is of value to the man who desires to become acquainted with widely varying methods used in design, fabrication, and field construction of steel bridges. The general specifications of the American Railway Engineering Association for steel railway bridges form chapter 14. The most valuable part of the book is that containing the 26 folding plates of general and shop drawings of various types of steel structures, taken by permission from the files of the C. & M. & St. P. Ry. These plates contain a wealth of information, representing good American practice in bridge designing and alone are worth many times the price of the book.

The typographical and physical make-up of the book are excellent. Mr. Wells' work will no doubt become popular as a reference book and practical supplement to the more theoretical treatises on bridge design, of which there are many.

GENERAL SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. By Jerome Cochran. Cloth, 6x9 inches, 274 pages, 21 figures. Published by D. Van Nostrand Co., New York. Price, \$2.50.

Numerous specifications for certain special kinds of concrete and reinforced concrete construction by individuals and various technical societies have from time to time been published, but very few works, however, have been comprehensive enough to cover this extensive field. This latest book by Mr. Cochran is an exception to this rule, covering as it does almost the entire field of concrete work. Specifications of this sort are not intended for use without study of the conditions but rather as a guide to the preparation of better specifications by engineers and architects, resulting in better concrete construction.

A feature of the book, which is very commendable, is the extensive bibliography in each chapter, giving references to specifications on the subject treated in that chapter.

The specifications given include those on: concrete materials, proportioning and mixing concrete, forms and centering, steel reinforcement, transporting and placing concrete, finishing and waterproofing surfaces, the design of reinforced concrete and reinforced concrete building construction. Appendix A gives formulæ for reinforced concrete construction as adopted by the special committee of the Am. Soc. of C. E.

The chapters on forms, steel reinforcement and design of reinforced concrete are especially good, the latter in particular being very comprehensive. In some minor cases improvements and additions could be made, but in general the work is very complete and deserving of a place in every engineer's library.

The L. & N. Ry. has a plant for the manufacture of reinforced concrete fence posts at Etowah, Tenn. This plant is equipped with 100 line and anchor post molds of the D. & A. type. The line posts are "U" shaped, about 8 feet long, 3½ inches wide at the top, tapering to 5½ inches at the bottom. These posts weigh about 100 pounds each and are cast eight at a time in "gang molds." The reinforcement consists of four ¼ inch or ½ inch square bars placed near the faces so as to give the greatest resistance. The anchor posts are 7 inches square at both ends and 8 feet long, reinforced in a manner similar to line posts. The fencing is attached to the posts by wrapping short pieces of soft galvanized iron around them to engage the line wires of the fence. The cost of such fastening amounts to about 1 cent per post.

The Signal Department

RAILWAY SIGNAL ASSOCIATION.

The stated meeting of the Railway Signal Association was called to order by President F. P. Patenall, signal engineer of the Baltimore & Ohio R. R., at 9:30 a. m. on Monday, March 16, in the Florentine room of the Congress Hotel, Chicago. The attendance was fully as large as that of last year, or of any previous March meeting.

Committees I, IV, V, VI, VII, X, and special committees on Methods of Recording Signal Performance, Signal Requirements of Electric Railways and Signaling in the Southwest, submitted reports for discussion.

AUTOMATIC BLOCK—COMMITTEE IV.

Outline of Work.

- (a) Prepare specifications for apparatus and materials used in automatic signal construction.
- (b) Continue on relay specifications.
- (c) Prepare specifications for field work in automatic block construction.
- (d) Continue on typical circuit plans for automatic block signaling, covering the simple and more common situations first.
- (e) Prepare specifications for dry battery.
- (f) Prepare specifications for switch indicators.

tery, it is intended to again present this at the June meeting, embodying such changes found necessary. The committee was not prepared at this time to present the method of test for "The Ampere Hour Capacity," and "The Effective Capacity of a Caustic Soda Primary Cell."

MANUAL BLOCK—COMMITTEE V.

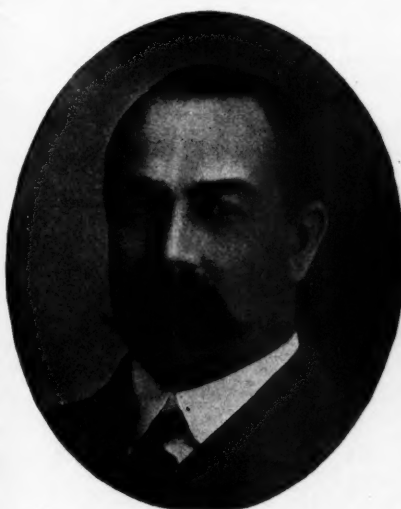
Outline of Work.

- (a) Investigate the relative advantages or disadvantages, and relative cost (installation, maintenance and operation) of the various kinds of manual block systems (manual, controlled manual and staff).
- (b) Continue preparation of rules for the maintenance and operation of interlocking plants and block signals.
- (c) Continue investigation of methods of handling trains by signal indications without train orders.

Personnel.

G. S. Pfisterer, Chairman; L. R. Mann, Vice-Chairman; E. T. Ambach, Hadley Baldwin, J. Beaumont, M. W. Bennett, E. A. Black, B. O. Darrow, Caleb Drake, M. J. Fox, H. K. Lowry, W. N. Spangler, T. S. Stevens.

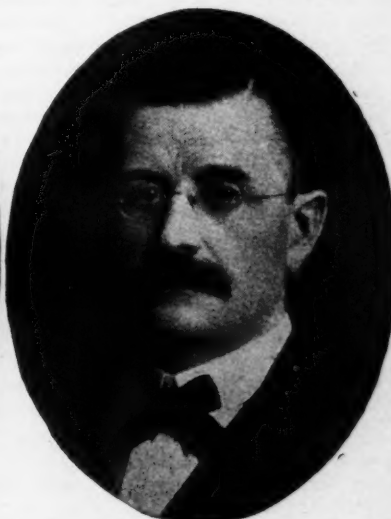
The committee submitted for consideration subject (b). Con-



F. P. PATENALL, President



W. J. ECK, Vice-President
Officers of the Railway Signal Association.



C. C. ROSENBERG, Secretary and Treasurer.

Personnel.

A. G. Shaver, Chairman; A. R. Fugina, Vice-Chairman; E. L. Adams, E. E. Bradley, G. H. Dryden, E. Folley, R. E. Greene, W. R. Hastings, W. H. Higgins, B. A. Lundy, R. M. Phinney, D. W. Rossell, E. K. Post, A. H. Rice, D. S. Rice, G. W. Trout, W. B. Weatherbee, F. E. Whitecomb.

The committee in presenting its report at this meeting was only prepared to submit certain specifications under assignment (a), as follows:

- Specifications for Wooden Pole Line Brackets.
- Specifications for Pole Line Washers.
- Specifications for Caustic Soda Primary Battery (revised).
- Specifications for Copper Sulphate (revised).

In presenting these the committee requested a full discussion on Specifications for Pole Line Brackets, Pole Line Washers and Copper Sulphate with a view of final presentation of these at the next annual convention.

Relative to the Specifications for Caustic Soda Primary Bat-

terry, it is intended to again present this at the June meeting, embodying such changes found necessary.

The committee submitted a resolution for presentation to the American Railway Association with the intention of securing recognition of the caution card as a means of moving trains past an interlocking signal at stop, where the stop indication is brought about by interruption of the signal apparatus, and the resolution is supplemented by suggested rules. These rules, if adopted by the association, are to be submitted to the American Railway Association with the resolution.

It is understood that the adoption of alternative rules will carry recognition of existing good practice and will not of necessity change present methods.

The rules for signal supervisors, as presented, include the rules which have been adopted by the American Railway Engineering Association, as shown in the Manual of that body, with such additional rules as the committee deemed necessary to more clearly outline the duties and responsibilities.

Resolutions Recommending Changes in Present American Railway Association Rules for Signalmen and Trainmen.

Whereas, This association recognizes the value of a caution card as a means of moving a train past an interlocking signal at stop where such stop is brought about by an interruption in the signal apparatus, and

Whereas, A number of railroads have adopted this practice. Therefore be it

Resolved, That this association recommends to the American Railway Association the following as alternatives to rules 629, 630 and 663 of the standard code:

Signalmen.

Present.

629. Signalmen must have the proper appliances for hand signaling ready for immediate use. Hand signals must not be used when the proper indication can be displayed by the interlocking signals. When hand signals are necessary, they must be given from such a point and in such a way that there can be no misunderstanding on the part of the enginemen or trainmen as to the signal, or as to the train or engine for which they are given.

Note.—Hand signaling includes the use of lamps, flags, torpedoes, and fuse signals.

630. If necessary to discontinue the use of any interlocking signal, hand signals must be used and notified.

Proposed Alternative.

629 (a). Signalmen must have the proper appliances for hand signaling ready for immediate use. Hand signals must not be used when proper indication can be displayed by the interlocking signals. The use of hand signals as authority to pass interlocking signals at stop is prohibited. Such movements must be made only under authority of a caution card, form This must be signed by the signalman and handed to the engineman as authority to proceed only after examination has shown the routes to be properly lined up and safe for train movements.

Note.—Hand signaling includes the use of lamps, flags, torpedoes, and fuse signals.

630 (a). If necessary to discontinue the use of any interlocking signal, train movements shall be made in accordance with rule 629 (a) and notified.

Enginemen and Trainmen.

663. Enginemen and trainmen must not proceed on hand signals as against interlocking signals until they are fully informed of the situation and know that they are protected. Trainmen must not give proceed hand signals which will conflict with interlocking signals.

663 (a). Enginemen and trainmen must not proceed against interlocking signals until they are fully informed of the situation and know that they are protected. Train movements shall be made in accordance with rule 629 (a). Trainmen must not give proceed hand signals which will conflict with interlocking signals.

Signal Supervisors.

701. Signal supervisor shall report to and receive instructions from the

702. They shall be responsible for the safe condition and proper maintenance of signals and interlocking plants. They must make temporary repairs of such defects as may endanger or delay the movement of trains and promptly report defective conditions to the

703. They must make frequent inspections of signals and interlocking plants and have necessary repairs made as promptly as conditions require. They must see that all failures of signals and interlocking plants are promptly investigated and report made on form number

704. They shall, as necessary, employ men for carrying out

the duties for which they are responsible.

705 (new). They shall instruct their subordinates as to proper methods of maintenance.

706 (new). They shall give each man specific instructions as to the limits of the work to which he is assigned.

707 (new). They shall not make changes in signal, locking or circuits without authority from

708. They must know that foremen are familiar with the operating rules in regard to train signals and flagging, and that they fully understand and comply with them.

709. They must, in case of damage to signals or interlocking, promptly assemble forces, tools and material, and make necessary repairs.

710. They shall investigate and report on accidents which may be attributable to defects in, or result in damage to, the signal apparatus.

711. They shall conform to the prescribed standards and plans in the execution of work under their charge.

712. They must know that foremen are supplied with tools and material necessary for the efficient performance of their duties and see that these are properly used and cared for.

713. They must not, except by proper authority, permit experimental trials of appliances or devices, nor give out information of the results of any trial.

714. They shall keep themselves informed in regard to all work performed in their district by contractors, or others who do not come under their charge, see that nothing is done by them that will interfere with the safe operation of signals, and report promptly to the if the work is not done in accordance with prescribed standards.

715 (new). They shall make such personal inspection and reports as are requested by

716 (new). When any changes are to be made in an interlocking plant affecting the operation of trains they shall consult with the superintendent and arrange for a time to perform such work.

717 (new). They shall keep a record of the performance of apparatus under their supervision.

718. They shall have immediate supervision of work train service for the maintenance of signals and interlocking plants in their districts, and employ such service only when authorized by the

719. They must know that foremen are provided with the rules, circulars, forms and special instructions and that they fully understand and comply with them.

Discussion.

Most of the discussion was upon the proposed rule 629 (a) as an alternative to rule 629.

A motion was made by Mr. Denney that rule 629 (a), as submitted by the committee, should not be approved for submission to the American Railway Association. Mr. Elliott seconded the motion and it was carried. The motion that the committee be authorized to prepare a statement outlining the situation for the American Railway Association consideration was also carried.

METHOD OF RECORDING SIGNAL PERFORMANCE— SPECIAL COMMITTEE.

Outline of Work.

Investigate and report on the basis now used on various railways in recording interruptions to traffic by signals and in computing the efficiency of signal performance.

Personnel.

W. N. Manuel, Chairman; L. L. Whitecomb, Vice-Chairman; C. A. Cotton, B. F. Dickinson, Paul M. Gault, S. B. Keller, G. W. Kydd, Geo. J. Patton, C. O. Warner, J. B. Weigel.

The following forms were submitted for consideration:

Form 11.

For the use of conductor or engineman and operator in reporting each signal interruption in accordance with the instructions

printed thereon and shown on Railway Signal Association drawing 1.

Form 12.

For the use of the dispatcher in recording the information transmitted from Form 11, the record of the message sent to the maintainer, his reply (by message), inscribing detention to each train on account of the signal interruption, in accordance with the instructions printed on the form. Copies of this report may be sent to various designated officers. Form 12 shown on the Railway Signal Association drawing 1.

Form 21.

For the use of maintainers in reporting the cause of signal interruptions to various designated officers, in accordance with instructions printed thereon and shown on Railway Signal Association drawing 2.

Form 22.

For the use of signal inspector or maintainer in recording and reporting monthly the number of signal operations, in accordance with instructions printed thereon and the general instructions. Form 22 shown on Railway Signal Association drawing 2.

Form 31.

For the use of signal engineers and supervisors (differing only in the amount of detail) for making monthly and annual reports to any designated officer or officers. Any amount of detail may be incorporated, and modifications may be made to cover special conditions, without material deviation from the basic design. Form 31 shown on Railway Signal Association drawing 3.

Considerable discussion was developed regarding Form 11, concerning the omitting of the items R. & O., but it was finally accepted as presented by the committee. Form 12 was also accepted.

STORAGE BATTERY AND CHARGING EQUIPMENT— COMMITTEE X.

Outline of Work.

- (a) Prepare specifications for apparatus and materials used in storage battery work.
- (b) Report on comparative economy of various methods for charging storage batteries.
- (c) Prepare necessary descriptive matter covering use of storage battery in signaling.
- (d) Prepare plans and specifications for operating switchboards.

Personnel.

R. B. Elsworth, Chairman; G. E. Beck, Vice-Chairman; J. G. Bartell, T. N. Charles, E. G. Hawkins, A. B. Himes, J. Fred Jacobs, T. L. Johnson, A. H. McKeen, T. J. O'Meara, John Parker, F. A. Purdy, A. H. Yocum.

The committee submitted its report for the consideration of the association:

A number of the subjects were presented in the form of a discussion in order to avoid unnecessary expense and confusion in the issuing of plates of drawings in preliminary form.

SIGNALING PRACTICE—COMMITTEE I.

Outline of Work.

- (a) Recommend aspect for instructions to trains to take siding at a non-interlocked switch.
- (b) Formulate and submit requisitions for switch indicators, including method of conveying information as to condition of the block to the conductor and engineman.
- (c) Investigate and report on automatic train control.
- (d) Economics in signal maintenance and operation.
- (e) Confer with special committee on Signaling Requirements of Electric Railways, on its report, recommending modifications deemed necessary to meet the peculiar requirements and conditions affecting signaling on electric railways.

Personnel.

T. S. Stevens, Chairman; C. C. Anthony, Vice-Chairman; H. S. Balliet, C. A. Christofferson, C. E. Denney, C. A. Dunham, W. J. Eck, W. H. Elliott, G. E. Ellis, A. S. Ingalls, J. C. Mock, F. P. Patenall, J. A. Peabody, A. H. Rudd, W. B. Scott, A. G. Shaver.

The committee submitted as information the results of tests of creosote used in treating cross ties and tests of cross ties treated with Carbondale creosote, supplemented by three diagrams.

In connection with the subject (d), economics of signal maintenance and operation, the committee submitted a report entitled: "Economics of Labor in Signal Maintenance."

STANDARD DESIGNS—COMMITTEE VI.

Outline of Work. (a) Continue preparation of standard designs. Personnel.

J. C. Mock, Chairman; C. C. Anthony, Vice-Chairman; G. E. Ellis, F. P. Patenall, W. A. Hanert, F. W. Pfeging, C. J. Kelloway, M. E. Smith, R. E. Trout.

The committee submitted several drawings in order to create a discussion that would guide the committee in its further work in submitting designs that would be accepted as standard, the following being a description of drawings presented:

Exhibits 1 and 2 show flat switch rods, wrought iron switch lugs of the socket type and wrought iron adjustment bracket. The only difference in the two layouts is that on Exhibit 1 is shown a short side connected lock rod and a center connected bolt lock rod; whereas Exhibit 2 shows the bolt lock side connected with a screw jaw and the F. P. L. center connected.

Exhibit 3a. The front is made up of two elongated and threaded switch lugs fastened with special short turn-buckle, threaded right hand at both ends. Adjustment in the front rod can be made by loosening the switch lug. The F. P. L. is center connected.

Exhibit 3b. Shows the detail of fittings that make up the front and lock rods. Location of insulation is indicated in dotted lines on the switch lugs and in the larger sectional view of lock rod connection.

Exhibit 4. Shows a side connected lock rod by means of screw jaw. The switch lug is shown in larger view.

Exhibit 5. Shows an assembly of the fittings the signal companies quite generally install for railroads when not otherwise directed by specifications and drawings.

The committee also submitted the following drawings:

Drawing 1049—Details and Assembly of Adjustable Lamp Bracket.

Drawing 1070—Binding Post (Supersedes Previous Issue).

Drawing 1094—One-Inch Pipe Line Insulation (Supersedes Issue 1901).

Drawing 1231—Vertical Type One-Way Pipe Compensator.

Drawing 1236—Two-Way (Single Lamp) Train Order Signal.

Drawing 1238—Details and Assembly of Marker Lights.

SIGNALING REQUIREMENTS OF ELECTRIC RAILWAYS —REPORT OF SPECIAL COMMITTEE.

Outline of Work.

(a) Bring to the attention of chairmen of other committees the peculiar requirements and conditions of electric railways that should be taken into account in the work of their committees.

(b) Recommend to the association such changes in the Standards and Recommended Practice and such amendments of the conclusions of other committees as may be deemed necessary to meet the peculiar requirements and conditions affecting signaling on electric railways.

Chairmen of other committees are requested to consult freely with the special committee as to electric railway requirements.

(c) Confer with Committee I—Signaling Practice, relative to modifications deemed necessary to meet the peculiar requirements and conditions affecting signaling on electric railways.

Personnel.

J. M. Waldron, Chairman;
R. C. Johnson, John Leisenring, C. H. Morrison.

The committee submitted as information aspects and rules which have been adopted by the American Electric Railway Association, and recommended for adoption as standard the aspects for trolley contact shown in Fig. 1 of the drawings presented.

The committee also submitted a number of definitions and other information on signal indications and general signal rules.

The form used on electric railways to report the failure of a signal was also submitted for discussion.

Data covering installations made on electric railways through the year from July 1, 1912, to July 1, 1913, was also submitted.

SIGNALING IN THE SOUTHWEST—SPECIAL COMMITTEE.

Outline of Work.

Analyze present specifications with reference to the particular conditions and requirements of the railroads represented by the members of the committee and submit recommendations.

Personnel.

D. R. Morris, Chairman; J. A. Johnson, Vice-Chairman; S. M. Bates, Paul A. Bliss, E. Hanson, B. F. Hines, T. S. Jobson, D. W. Rosenzweig, E. P. Weatherby, E. E. Worthing.

To the Members of the Railway Signal Association:

The committee submitted a preliminary report by stating that they had held one general meeting, this being at Dallas

on November 25, there being five members present. At this meeting the principal feature was the organization of the committee, assigning various portions of the work to the different members, as well as arranging for meetings of various subcommittees. At a second meeting of the committee, called for January 7, at Galveston, three members were present, but very little work was accomplished.

SUBJECTS AND DEFINITIONS—COMMITTEE VII.

Outline of Work.

(a) Prepare definitions for technical terms connected with signaling, particularly any terms which discussions show are not properly defined.

(b) Compile definitions in the form of a Signal Dictionary, giving terms and definitions only—without descriptive matter.

Personnel.

E. G. Stradling, Chairman;
A. D. Cloud, Vice-Chairman;
P. M. Gault, C. G. Stecher.

The committee submitted a number connected with signaling, particularly terms which discussions show are not properly defined.

Note.—In view of the fact that there was not sufficient time at this meeting to criticize the various definitions presented, the committee requested that members submit their criticisms on any word or words to the chairman. After receiving the same the committee will give the matter full consideration.

The Maintenance of Way Department

RAIL CREEPING No. 1.

D. O'Hern, Roadmaster.

Anti-creepers are a necessity on all double tracks where traffic is all one way. We use five anti-creepers to a 33-ft. rail, 40-in. anglebars; four anti-creepers to 30-ft. rail, 24-in. anglebars; two opposite each joint for 24-in. anglebars and three opposite each joint for 40-in. anglebars. We place one anti-creeper on each quarter or more, if necessary, according to condition of roadbed.

Track creeps worse in the spring when the frost is going out. The frost goes out of the ballast first and leaves frost under the tie, making a slippery roadbed, and consequently the track is more apt to creep then. On a long down-grade with heavy traffic seven and eight anti-creepers to a rail are necessary; the danger point of track buckling is where it approaches the up-grade, as the engineman sets his brake to control train going down grade, causing wheels to slide. Where there are peat-bogs and marshy substances for roadbed, anti-creepers are necessary on account of spring of loose fill in the roadbed, causing track to creep more than on solid roadbed.

The best ballast, in my opinion, to keep the track from creeping is slag. It is a refuse from furnaces, and there is more or less lime in it, forming a concrete, holding ties solid and with spikes driven tight to the rail, joints spiked in slots and anglebars, makes it more difficult for rail to creep.

We are using Mikado type engines, total weight 307,000 lbs., and our traffic is heavy, with an average of fifty trains a day, tonnage average of 3,200 to 3,700 tons per train.

On single track we use creepers only where our road runs through peat-bog or marshy country. Track through territory like this will creep both ways, and anti-creepers should be put on to protect against creeping in either direction, using your own judgment as to how many anti-creepers it will take to hold track in place. Drainage is a great preventive for rail creeping. The drier the roadbed becomes the less the track will creep.

We use P. & M. and Vaughan rail anchors, both being good.

I find a great many anti-creepers on the market and I consider them all good. We use 85-lb. and 100-lb. rail, and the heavier the rail the less it creeps; furthermore, properly laying the track will have a tendency to prevent creeping. In relaying rail, expansion shims to fit all conditions of weather should be furnished, and then used correctly. The man in charge of relaying rail should carry a thermometer on the job.

We have some two per cent grades, where we use seven anti-creepers to a rail. We have no trouble holding rail with this number of rail creepers. We also have good drainage. It would not be necessary to spike in slots holes at joints if you had enough anti-creepers to keep rail from creeping. I consider four spikes in slot holes at joint to be equivalent to two anti-rail creepers, and as it is the custom of most railroads to have slots in all anglebars we live up to the practice of spiking in slots.

RAIL CREEPING No. 2.

J. J. Hess, Asst. Engr. Maint. of Way.

Regarding the subject of rail creeping, I do not know of any subject of greater importance in the railway department, as from my point of view it affects almost every feature of maintenance. By causing ties to become slewed it seriously affects gauge, line, surface and drainage, four of what are conceded to be the most essential features of good track. By also causing inequality of expansion, rails become badly battered at ends, anglebars become slot worn, bolts break or become loose and battered, spikes become worn and heads are cut off, due to rail movement, and there is great wear and tear on ties. Rail creeping also causes stock rails at switches and wing rails of frogs to get out of proper position, ends of rail at turn tables and on scales to interfere, as well as causing latter to get out of adjustment. Creeping rail also throws railroad crossings out of line and interlocking plants out of adjustment. It also causes track to kink and buckle, thereby being the cause of accidents that are sometimes attributed to causes unknown, the evidence, perhaps, having been destroyed. Great

trouble is experienced on lines in Minnesota, due to there being so many swamps, marshes and what are termed muskeg swamps.

RAIL CREEPING, No. 3.

By J. J. Bethune, Roadmaster.

Following are some of the causes of rail creeping:

(1) The effect of gravity, from the top of the grade to a sag, together with the application of the brakes to the wheels on the down grade, is the first or aggressive cause. (2) Track laid without the proper spaces left at end of rails for expansion, this causing rails to creep in the direction of least resistance, if there were no trains running on it. (3) Track not properly buried in ballast to prevent ties moving sideways. (4) Spikes not driven down tight in contact with rail flange. (5) Slot spikes at joints getting worn out, and in some cases breaking off. (6) Joint bolts not kept perfectly tight. With the exception of the first cause these can, by close attention, be, to a certain extent, remedied.

In order to prevent rail creeping, or at least reduce it to a minimum, track must be well ballasted and filled within one inch of top of tie, with good heavy gravel or broken stone ballast, tie properly spaced and placed at right angle with rail, spikes at intervals kept driven down with head in contact with rail flange, slot spikes kept in good condition and in place, track bolts kept tight, and I have found it a good plan where joint ties kept pushing down grade in light ballast to put short struts made of 2x3 spruce between ends of ties on the down grade side, for three or four spaces, in order to get the support of the side thrust of three or four more ties to assist joint tie. No doubt the best preventive and final one, with the other conditions I have mentioned being attended to, is to apply a good anti-creeper, of which there are many on the market. I am not in a position to recommend any particular kind, as my experience in the use of them is limited.

But there are some peculiarities about rail creeping that are difficult to solve. I have in mind a piece of track on my own division on a down grade of 1.4 per cent and curves of 9 degrees. On three miles there is only 3/10 miles of tangent altogether, made up of short tangents between curves. The right and left curvature about balances, track direction being about due east and west. This piece of track has in two years crept 18 in. more on the north rail than on the other. It would be reasonable to think that on a long simple curve that the outside rail would have a greater tendency to creep on account of the continual side friction of the wheels, but in the case I have mentioned, on account of the curves being about balanced, it is natural to conclude that the creeping would be about equal on both sides of track. I would be pleased to have the opinion of some of your correspondents on this point. The only reason that I can see for this difference is that perhaps the heat of the sun in summer would have a better chance to strike the north rail during midday, especially in clay cuttings, where the south rail would be, to a certain extent, sheltered.

RAIL CREEPING No. 4.

G. K. Thornton, Division Engineer.

I have noticed the greatest amount of creeping occurs on double track where the grades are generally down hill. This has been greater on soft ground, like swamps and salt marshes, than it has on a good, solid roadbed. The ballast has always been good gravel about 18 in. deep; the rail 75-lb. and 85-lb per yard; track has been well tied with 19 ties per 33-ft. rail; traffic consists of about 20 trains per day, with a tonnage of about 15,000; locomotives are of various types, from light eight-wheel engines to consolidation class. We have frequently had the track run 12 in. in a year, although each joint was fully spiked to the ties with four spikes in the Weber type rail joint.

We have made no especial system of inspection, simply kept watch of it, and before hot weather have driven it back and given the joints proper expansion. In some cases we have put on strap joints, and these straps have been long enough to run back onto three ties, to which they would be securely spiked. This has helped out considerably, but the wave motion on the soft roadbed has caused the spikes to work up so that they are not entirely satisfactory; furthermore, they look clumsy in the track.

We have been using the past two seasons patent anti-rail creepers, putting on four or five to a rail length. These have shown excellent results, and experience with them leads us to believe that a sufficient number will hold the track with very little movement.

RAIL CREEPING, No. 5.

Ed. L. Flinn, Foreman.

There have been many devices of various design invented, and in one way or another placed on the market, for the purpose of bettering conditions on grades where trouble has been met with the creeping of rails. In most cases conditions have been improved where the devices have been properly applied, but I think observing trackmen will agree that the trouble on heavy grades has not been entirely eliminated. And I will go so far as to assert that (in my opinion) with the present devices it cannot be wholly overcome unless a considerable number of the anti-rail creepers per rail are used, which would necessarily involve great expense, both in the cost of the devices and in the cost of labor to maintain them properly.

Some of the devices now in use are very good, but the number per rail, so far as they have come under my observation, has been insufficient to afford ample anchorage, therefore the desired results have not been obtained.

Of course, conditions in respect to ballast must be considered, as it is a known fact that weight of some kind must be thrown between the ties to hold them in place as nearly as possible. I think something like crushed stone serves the best for this purpose, as ties in this kind of ballast do not slew so easily as in other kinds of ballast. I have noticed that if track on grades is well ballasted it tends to better conditions, as the less wave motion produced from the weight of traffic the less they will launch in track. Conditions could be bettered if an order could be enforced whereby engineers would be required to coast down grade, instead of running at a high rate of speed up to the approach of a down grade, and then applying the brakes in such a way as to drag the train. I have seen enginemen, while going down grades, apply and release the air all the way down on a 2 or 3 per cent grade, and on following the train on handcar I could see marks of wheels sliding on almost every rail all the way down. This is wrong. Of course I understand that there are grades, and especially on mountain roads, where it is necessary to hold the brakes from top to the bottom, but where possible, precaution against this should be taken.

I have seen cases on 2 per cent grades where ties at the joints were pulled to an angle of about 20 degrees across the track within a year; and I feel sure that the direct cause was allowing trains to come down with the air applied more or less. I think, too, that when rails are laid, and especially if they are relaid, and anti-rail creepers are to be used, a sufficient amount of expansion should be given each rail and the joints tightened enough to insure against lips on the rails, and yet loose enough to allow the rails to freely contract and expand; by doing this the expansion will remain uniform longer and track will, as a result, creep less.

Expansion in laying or relaying rails is of more importance than some foremen, or even roadmasters, think, and time should not be taken into consideration so much in making this feature correct. This, like almost all other maintenance track work at this day and age, is done with the one idea of filling out a good-looking weekly or monthly report, regardless al-

most of what substantial results are obtained at the end of the year. In conclusion, and in connection with former articles I wish to reiterate, it should not be a question of the amount of work shown on paper at the end of a given period, but what actual ultimate results can be shown on work at the end of a year.

PRACTICAL AND ECONOMICAL METHOD OF RENEWING TIES.

By J. P. Haddix.

The season of the year is fast approaching when tie renewals will be in full blast, and since the business outlook is not very promising for the railroads it is probable that section gangs will be small until the prospects of good crops are confirmed.

Tie renewals are a large part of maintenance expense and a method which will increase the capacity of a man to the extent of putting in one or two additional ties per day will amount to quite a saving to the company. If this can be accomplished without greater labor, or especially with a decrease in the amount of labor, the method will be just that much more valuable.

A most important part of the work is going over the section and marking the bad ties and taking note of just where they are located, so that new ties can be distributed from trains correctly. In this manner the work of hand distribution is cut down considerably, thus decreasing the cost by eliminating unnecessary labor.

Where fills are high, ties can usually be unloaded at each end so that they will not roll down the bank. It is cheaper to distribute these by push car on the bank than to pull them back up the side of the fill. Care should be selected in replacing ties with new ones as near the same size as possible. This reduces work of tamping and filling, and leaves a better distribution of the ballast.

If a foreman has only one man and is willing to work a little himself the following method will be found advantageous and show results in gravel, cinders, rock, clay or sand ballast: Dig a trench on the side of the tie where the greatest space is available, digging down not further than one inch below bottom of old tie. On curves the ties should be pulled out on the high side of track, that is, on the outside of the curve, thus decreasing the amount of digging necessary. After the trench is dug, pull the spikes from the old tie, place jacks on each side of the track and raise the rail about a half inch. The old tie can then be pulled out easily and the new one inserted on the old tie bed. The tie bed should not be touched unless the new tie is thicker than the old one, and in that case should be cut down only enough to just barely allow the new tie to be put in. If the new tie is thinner than the old one it can be spiked up and tamped without disturbing the old tie bed. This method is easier and results in the new tie being solid and requiring no more attention than the undisturbed ties.

Plates are also more easily placed on the ties using this method. If the foreman has three men, one can be put to work digging trenches and pulling spikes out of the bad ties, and one man can be set to work filling in and spiking up the new ties. Personally I like to see a tie put in solid enough so that it will stay up under the rail while being spiked, without using a nipping bar.

A foreman should always inspect the tamping and spacing of the ties personally, and with less than four men he should take some active part in the work.

If the section gang has only one jack the same method can be used, jacking up one side of the track and blocking it about a half-inch high and then moving the jack across and raising the opposite rail. Where two or three ties at one place are to be renewed it can be done by setting the jacks only once. In a very short time the foreman will be able to estimate just how high to raise the rails in order to get the ties out and in most easily. I have used this method with 40 or 50

men, using two jacks, assigning sufficient men to dig the trenches and two men with jacks.

The track will look a little bad where ties are put in this way until a train or two has run over it.

If more than two men are at work putting in the same tie nearly always some one will be standing idle. I know from experience that with this method of renewing ties at least one and probably two ties more per man can be put in and they will be in better condition than if put in by the old method of driving out with the maul and digging down the old bed. In every case the track can be sprung enough to give sufficient room to get the tie out and yet not high enough to allow the ballast to run under the adjacent ties. The spikes are nearly always a little loose, so that the rail can be lifted a little without lifting the ties at all.

If old ties are to be picked up and piled, work can be saved by taking care that none of the ties roll down the sides of the fills, but they are piled up lengthwise on the shoulder. A pick is handy to pull out the old tie with, but should always be stuck in the side and not in the top of the new tie. The pick, of course, should be used when it is necessary to cut down the old tie bed.

I think that a trial of this method will surprise some track men in the ease with which the work can be done, in the greater quantity of work turned out, and in the better condition the track will be left in.

WRECKING.

By Jos. J. Morgan.

Wrecks generally occur when they are least expected. Regardless of how rare their occurrence may be, if it is a steady rule to be always prepared for such emergencies there need be little fear of them.

When a wreck occurs, accompanied by its many destructive elements, the first requirements of this department are men and material. The section foreman is here an important factor. In a pinch like this his reliability, or on the other hand, his unfitness, is brought out conspicuously. If the foreman is strictly on the job and manages to keep cool, he will size up the situation quickly, ascertain as closely as possible the amount of damage to track, and notify headquarters by wire what material is required.

Where a large force is necessary to handle a wreck, the nearest section and extra gangs are hurried to the scene of the trouble either by means of passenger or wrecking train. In some locations the territory of a section gang takes in several stations, and it is sometimes difficult to locate the gang when required without the loss of much valuable time. However, this difficulty can be easily eliminated. On lines where a daily reporting system is in vogue the foreman should specify on the report rendered each day, the probable location of the gang on the day following. Another even more dependable way would be for the foreman each morning to notify the station agent at section headquarters just where the gang will be working during the day. With this information at hand the matter could be handled more expeditiously, as it is often necessary to locate a section gang during the day, not alone for wrecking purposes, but for various other reasons as well. And the services of section gangs should be readily available.

A regular gang should be assigned to the work of wrecking, as it is absolutely essential that the men be experienced in this line in order to insure prompt handling of the situation. At least one man in the wrecking gang should have telephone connections, and his first duty should be to notify the rest of the gang when called upon for night service, the men, of course, to be located as near as possible to headquarters. With this arrangement very little time would be lost in getting the force together. A regular relief gang should also be maintained. After working a reasonable length of time on a large wreck

the men could then be relieved, and better as well as quicker results would be sure to follow.

The permanent location of the wrecking outfit should be close to the material storehouse. An emergency supply of spikes, bolts, ties, rail and other material usually required for such occasions, should be constantly kept in reserve at the storehouse. Then, when advice is received from the foreman as to material required, there would be practically no delay in supplying material sufficient to at least temporarily restore the use of the tracks.

But the telegraphic account of a wreck received from the foreman is sometimes sadly lacking in information; in fact, it is often useless. We should not be too severe with the foreman on this account; for competent men, whose ability as foremen is beyond questioning in the ordinary run of affairs, have been known to lose their heads completely when confronted with the proposition of a wreck on their hands. Notwithstanding instructions, they seem to forget everything in regard to the information required of them. One way of remedying this is to furnish the foremen with a regular form, similar to that given below, for the telegraphic reporting of wrecks, all information, of course, to be given as briefly as possible.

Wreck Report.

(A) Train No. (B) Date and time
(C) Location by M. P. (D) Cause (State facts briefly)
(E) How many cars derailed? (F) Tracks blocked?
(G) No. injured (H) Damage to track (see note).....

Foreman.

Note: State briefly amount of track torn up, and quantity of ties, rail, bolts, etc., required.

From this report a pretty fair idea of what is required in the way of labor and material could be found, and it would, no doubt, result in the saving of considerable labor and inconvenience. The emergency material could be loaded on the wrecking train and delivered immediately, thus doing away with the necessity of an extra trip for the material actually required. In short, it would tend to lessen the delay, inconvenience and loss which invariably accompany wrecks to some extent.

Passenger wrecks present a more serious aspect, as compared with freight wrecks. More or less suffering generally follows in the wake of a passenger wreck, and immediate relief is imperative. Steps to afford such relief should not be deferred until the actual occurrence of a wreck. Take, for example, some of the recent passenger wrecks which resulted disastrously. We have no absolute guarantee that such calamities will not come our way, notwithstanding our utmost precautions. Is it not plain, therefore, that we should be always prepared? There is no time for making arrangements and planning when the lives of others are at stake.

The "hospital car," recently inaugurated on the Chicago, Rock Island & Pacific Ry., has a peculiar fitness for use in connection with passenger wrecks. Its equipment includes the different necessities for the care of the injured, such as suspended spring beds, wash stand, medicine chests, operating table, etc. The adaptability of this car for emergency use is indeed worthy of favorable consideration. Accompanied by the railroad physicians, the car could be conducted to the scene of the wreck, where it would certainly be of great service in cases of severe injury.

Taking everything into consideration, we are forced to conclude that, for the proper management of wrecks, the following are outstanding requisites:

Reliable organization. Perpetual preparedness. A cool-headed director.

ROADWAY STANDARDS, C., M. & ST. P. RY.

C. E. Foreman.

The following specifications and standard plans were made up for roadway construction in Montana east of Butte and for South Dakota:

Roadway Standards.

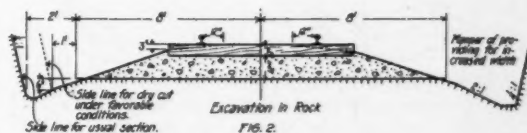
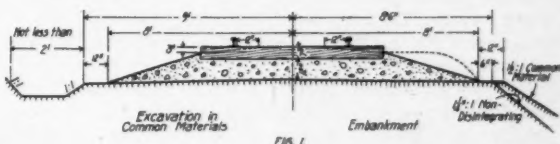
Proper interpretation of these plans and specifications will provide for settlement in embankment, ditches below the ballast in cuts, increase in the sections where necessity exists, and where practicable a reduction of section, resulting in a roadbed economical but sufficient at all points for carrying the permanent ballast.

Sub Grade.

Roadbed will be finished and measurements are given at sub-grade, which is twelve (12) in. below the base of a seven (7) in. tie, and is to be maintained on curves, on the center line of track.

On curves roadbed will be finished on a slope parallel to the curve elevation.

On tangent, for material that will not drain, roadbed will



Standard Roadway Sections.

slope each way from center, giving a two (2) in. crown. (See Figure I.)

Slopes and Shrinkage.

Embankment shrinkage will be estimated and so allowed that after settlement it will insure full roadbed section for support of ballast. Use the following slopes:

Common materials 1 1/2 to 1
Non-disintegrating broken rock on insecure footing.. 1 1/2 to 1
Non-disintegrating broken rock on secure footing.... 1 1/4 to 1
Non-disintegrating broken rock on steep slopes, on secure footing and with outer portion and slope of selected rock hard..... 1 to 1

In excavation use the following slopes:

Excavation: Common materials 1 to 1
Hardpan and cemented gravel 3/4 and 1/2 to 1
Solid rock 1/4 to 1

Slopes to be increased as material requires for stability.

Roadway Sections.

See Figures I and II.

The width of sub-grade in common material is to be as follows:

If material is first-class ballast, continue slope and complete sub-grade three (3) in. below base of tie at the width of 15 ft. 9 in. (15' 9"), affording material for surfacing from the shoulder.

The width of embankment sub-grade in non-disintegrating rock is to be 17 ft.; excavation, rock (roadbed 16 ft., ditches 2 ft.) 20 ft.

Rock cuts on tangents and light curves, without probability of slides, and where the excavated material or more adequate provision for drainage is not required (roadbed is to be 16 ft., ditches 1 ft.), total, 18 ft.

On common materials the width is to be 22 ft.

In first-class ballast place sub-grade three (3) in. below base of tie (roadbed 18 ft., ditches 3 ft.), total, 24 ft.

Widths will be increased to meet the requirements of drainage, protection against slides, clearance, etc.

Tunnel Sections. (See Figures III, IV and V.)

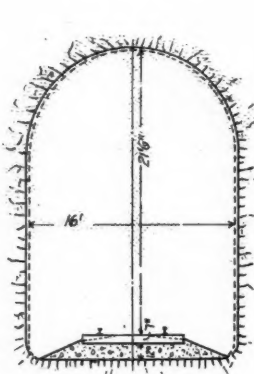
	Between sidewalls	Top of tie to center of arch
Lining not required	16 ft.	21 ft. 6 in.
Lining required (timber removable during masonry construction)	20 ft.	23 ft. 3 in.
Lining required (timber not removable during masonry construction)	20 ft.	23 ft. 3 in.

Plus thickness of timber.

The clearance will be increased where necessary for curvature and elevation, corresponding to the requirements of an 80-ft. car, 64 ft. between truck centers.

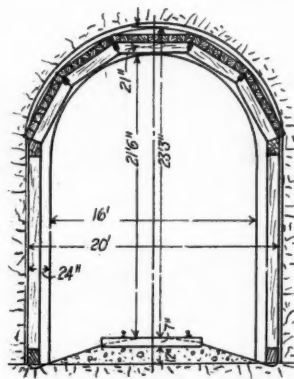
Estimated Balance of Non-disintegrating Rock in Embankment.

	Meas. in Excavation Cu. Yds.	Will make in Embankment Cu. Yds.
Favorable conditions, including overbreak	1.0	1.6
Embankment on substantial footing, overbreak and slides heavy	1.0	1.9



Lining not Required.

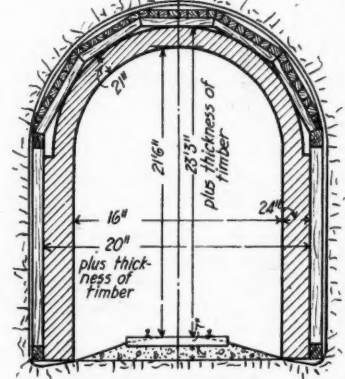
FIG. 3.



Lining Required - Timber removable during construction.

FIG. 4.

Standard Tunnel Sections and Linings.



Lining Required - Timber not removable during construction.

FIG. 5.

Embankment on treacherous footing, overbreak and slides light

1.0

1.3

Determine early after commencement of work for each material, probable rate of balance, and where required and practicable, more closely adjust the alignment to minimize quantities.

Roadbed on Sidings.

If a siding is to be ballasted, decrease standard widths at sub-grade two (2) ft. and place sub-grade for eight (8) in. of ballast. If not to be ballasted, decrease standard widths at sub-grade four (4) ft. and place sub-grade two (2) in. below base of tie. Space passing tracks thirteen (13) ft. where grading is heavy, fourteen (14) ft. where grading is light and increase for clearance where required.

Ballast.

Above the sub-grade specified use only ballast of good quality. If necessary to temporarily use a poor quality of material for ballast raise track above sub-grade as little as practicable, generally not to exceed four (4) in., and preferably so construct the roadbed that such temporary ballast will be below the sub-grade, forming the top part of the roadbed section. Where partial ballasting only is performed track should be finished, for the time, below the permanent grade, to which it will be raised when ballasting is completed. On newly constructed embankment any surplus of ballast material

may be left on the shoulder within the limit of the dotted line on the sketch showing embankment. (See Figure I.)

WINTER MAINTENANCE AT ENDS OF NEW BRIDGES.

By J. P. Haddix.

A few years ago I had charge of an extra gang at Edgemont, S. D. This is at the foot of the Black Hills, on the Cheyenne River bottom, the formation being of sticky clay, probably of volcanic origin. The track had been used for several years and had given no trouble. When we quit work one night the track was in good condition. The next morning one switch had sunk about 18 inches. This switch was located in the ladder track and was used the same as the others. We used cinders to surface this with and we had no more trouble with it.

Another place went down about 500 feet from this switch in about the same way. We raised it on cinders also and it gave us no more trouble. The ground seemed soft for several feet down. I thought perhaps that some underground waterway had been stopped up, and the water was forced to the surface. This was in the month of March, after a very hard winter, and the weather had become unusually warm and the frost had gone out of the ground very fast. As cinders are nearly always available, and since water does not affect them and they are easily tamped, they can be used to good advantage in such cases.

My opinion is that in cases where the sink is of great

depth, coarser ballast should be used, some material that would have the broken joint effect, something on the brick wall principle, to form a base or bottom.

Quite often short concrete culverts are put in to replace longer bridges. The culverts are made, the bridges are filled up to the stringers and enough material is piled on each side to fill the space. When the stringers are removed, such places settle badly if the bridge is very high, and should be watched very closely for a few days. These places should be raised higher than the surface of the track each side. Cinders are very good for raising such places to surface, as they are easily and quickly tamped and are not very expensive. A good supply of them should be kept piled on each side of the track. Then, in case of a heavy rain, which most always causes these places to settle badly, the track can be raised at once. Cinders are also very convenient to tamp in the winter when the frost is in the ground.

A good idea is to not fill between the ties in these places, but just against the outer ends of ties so as to hold track in line. Then in case the track needs surfacing it is easily raised in the coldest weather. This saves lots of hard work and time picking the ballast out from between the ties every few days to surface the track. Cinders absorb a great amount of water and will keep the water from wetting up the fill or roadbed and keep it from getting soft under the track. After newly filled places get settled, more expensive ballast can be used.

WASHOUTS.

J. N. Newson.

Preventing and repairing washouts is the most dangerous and costly problem that a railway system has to contend with. And during recent high waters trackmen learned many new methods. The trackman is the first to find a place made unsafe by high water and is always first on the scene, doing all he can to safely pass trains over such places.

First, let us consider the cause of high water which causes washouts. We sometimes have cloudbursts, sending great torrents of water which it is impossible for our waterways to carry off as fast as the water gathers. Again, we have seasons of rain, causing streams to swell, sometimes washing bridges, embankments and culverts away. Again, a dam somewhere up the stream may burst. Now let us consider the ways of inspection to find the condition of roadbed, culverts and bridges. I think the foreman should do this inspection in rainy seasons and at times of high water. In track flooded with water about one or 2 feet deep, a man should walk carefully over this track and examine the roadbed to see that it will pass trains over safely. He should examine culverts and find out, if possible, if water is undermining the culvert bed. All bridges should be examined; a good way to find weak places in bridges is to notice all bents and see if they are in true line and surface, and if caps on bents fit up tight. Nearly all trackmen can tell, by various methods, whether track is safe.

When our railroads were being constructed, very few cuts or embankments were built as they should have been. Few culverts were put in at that time and nearly all streams were crossed with trestle work. Later on, culverts only about one-half the proper size were put in and we have more water to take care of now and pass off by our waterways, than did the trackmen fifty years ago, for this reason: We have more open land now, more of our swamps have been cleared, and there is not sufficient vegetation to exhaust the regular supply of water from these streams. Therefore, now and in the future, we should undertake to build our waterways, to prepare for years to come.

Precautions should be taken to prevent washouts, such as proper ditching in cuts and building embankments in such shape and manner that common floods will have no effect. Ditches in cuts are very important factors in railroading. The drawing herewith gives my idea of a cut properly ditched for rock ballast track and common clay sub-ballast. Our cuts should be well ditched out, and should have a good slope, sufficient to prevent sliding. If possible, the slopes should be well sodded with Bermuda grass, and the tops also, say 15 ft. from edge of bank. A nice ditch, 2 ft. deep and 4 ft. wide, should be graded on top of cut to carry the water each way and at end of cut these ditches should carry water a proper distance from base of embankment; such ditches intercept water that falls on top and prevents it from running over side of cut and emptying into track ditches.

All embankments are built up with loose dirt and therefore are not firm as solid dirt which has never been broken. We should endeavor to work out plans whereby we can build embankments to withstand flood waters. Sketch herewith shows plans for an embankment built up for rock ballast and common clay. Embankments should be built up flush, eleven feet wide on top for roadbed, with slope well sodded with Bermuda grass or some other grass of holding qualities. Or set out young willow trees at base of embankment, and as the willows take root and begin to grow, bend the tops flat on side of embankment and cover with earth. Do this regularly until the entire embankment is a network of roots. We should cut all heavy brushes, except the willows, that grow on embankments, but I think we should not burn the trash and grass on embankments. A good way to begin this growth of willows would be to dig a ditch about two feet deep at base of embankment and set out the sprouts very thick in it and

refill ditch. Put a similar ditch about half way up side of embankment.

In places where a stream runs along by the side of embankment, I think these banks should be built up especially strong and set with willow sprouts. Then beginning at base of fill place large rock on side of fill, using a derrick.

All culverts that are too small should be torn out and replaced with larger ones. All streams should be cleared of trees, brushes and trash for 100 yards at each end of culverts and waterways. Culverts put in at dry ditches for the purpose of carrying off water when a rain comes, should be kept open at all times.

I think the smallest size pipe we use should be not less than twenty-four inches, and then we should use two rows placed side by side, with a good concrete face and apron. This face should be about ten feet high from bottom of sewer to top of concrete wall, which should not be less than eight inches thick. An apron made of concrete similar to that shown in the diagram would be satisfactory. With this apron nine feet wide at end of waterway and extending three and one-half feet out in front of sewer, water could not easily undermine sewer pipe.

But after all our efforts are used to prevent them, great washouts occasionally occur. A good way to hold track down and in place is to use loose or scrap rails, spiking them to ties along inside of track rails. If track bed is washed out in cuts, use cross ties as stringers and sills, using shims to get a surface. High water causes embankments to slide off. If part of the bank is washed out and part remains, a quick way to get over it is to throw the track out on the edge of bank and if not wide enough, use ties, switch or bridge ties preferably, to make a crib and cord. When bank becomes very narrow, let a long sill go under and across track bed, resting on a bed made of ties on opposite side of track and on crib on reverse, using this as a cap. In some cases we can lower grade to get sufficient roadbed to carry trains over safely. If water is so ties will not stay in place when making crib, sink them with old iron. A good plan would be to put in large sewer pipe through the embankment at regular intervals to carry off the accumulated water faster.

Sometimes the entire embankment goes out at the end of a bridge. When it does, if the pile-driver can not reach you, go ahead and use ties, logs and old rails to build a temporary bridge. Perhaps there may be a larger washout farther on. Circumstances have a great deal to do with the proper handling of these matters and practical experience determines the best plan to pursue.

PANAMA RAILROAD CROSS-TIES.

Black Guayacum Variety Laid in Early Days Has Stood Test of Time.

The chief engineer of the Panama railroad has prepared a report of the use and life of hardwood ties laid in the roadbed of the line since 1878, and specifications under which they have been purchased since the United States assumed control of the road. The report, in part, is, as follows:

The original track of the Panama railroad, as it existed in 1885, before being disturbed in any way by Canal operations, was laid with small hardwood ties obtained on the Isthmus, and from Colombia. The greater part of these ties were procured from the north coast of Colombia, and were shipped to Colon from the port of Barranquilla. They were of a variety of wood commonly known as *lignum vitae* (*guayacum resinosa*), and now spoken of as black guayacum, to distinguish it from yellow guayacum, a wood of the same family, but with less power of resistance to mechanical wear or decay.

Other varieties of wood, such as balsamo (or quira), and polvillo, were procured by the company, but the only species available at the present time are a few balsamo ties, which were laid in the old track near Mount Hope in 1900, and which were

taken out of the roadbed last year, and replaced by a larger tie. Practically, the only wood that has stood the test of time is the black guayacum, procured in the early days of the railroad's operations.

The guayacum ties procured by the old company were very small, being "pole" ties, about five to six inches thick, with a 6 to 7-inch face, eight feet long; some of them were quite crooked and irregular in shape. These carried the light traffic of the railroad prior to American Canal operations without difficulty, but when construction work was begun in earnest, it was found necessary to replace the small ties with those of a larger dimension.

There has been so much said about the long life of these hardwood ties that it would be well to set forth what little authentic information is available. The following are extracts from the annual reports since 1878:

1880—About 5,000 new *lignum vitæ* ties have been placed in the track.

1884—During the year, 30,000 *lignum vitæ* ties have been put in, and during the coming year, 3,000 additional will be required.

1885—During the year 1885, 10,000 *lignum vitæ* ties have been received and put in the roadbed. The existing contract for the 30,000 spoken of in the annual report of 1884 will complete the work for the present.

1886—The number of *lignum vitæ* ties put in the road in 1885 amounted to 10,000, while in 1886, over 20,000 have been received.

1888—The number of *lignum vitæ* ties placed in the main line during the year was 5,456, and upon deviations (branches), 8,747.

1889—Such is the durability of *lignum vitæ* cross-ties used in the track that only 5,855 new ones were required for the year.

1890—The track has been kept in excellent condition, although only 4,014 *lignum vitæ* ties were received during the year.

1891—The general condition of the roadbed and track continues excellent. Only 6,167 *lignum vitæ* ties were laid during the year. The exceptional durability of these ties (about 30 years, when of good quality) reduces the number of yearly requirements to small proportions.

1892—Four thousand one hundred and twelve *lignum vitæ* ties were laid.

1893—Four thousand five hundred and seven genuine *lignum vitæ* ties were laid, and 2,539 of native hardwoods for sidings.

1894—Seven thousand one hundred and ninety-six *lignum vitæ* ties were laid.

1895—Ten thousand two hundred and twenty *lignum vitæ* ties were laid.

The main line of the roadbed was first double-tracked from White Horse (near Las Cascadas) to Tabernilla, to provide for the movement of the spoil trains to and from the Tabernilla dumps, and it was found necessary to remove many of the small hardwood ties from the roadbed in this section, on account of the increased traffic. These small ties were allowed to remain in the track in the section between Empire and Culebra, where the line was double-tracked, and where the traffic was comparatively light. There are many of these old ties still in use in the roadbed in that section.

The hardwood ties laid in the old track were, generally speaking, in very good condition. There were little, if any, signs of decay, but in many cases, especially with the smaller ties, they were badly worn at the rail seat by the mechanical action of the base of the rail, no tie plates being used on the ties. They were also "spike killed," caused by replacing spikes and changing rail. It will be interesting to note that many of the ties removed from the main track at that time, and later, are now being relaid on the tracks connecting with the new terminal docks at Cristobal. The timber in the ties is practically as good as ever. As their smaller size is not objectionable in the yard tracks, it is expected that they will still have a long life in other services. Tie plates are not necessary with these ties, which results in some saving.

The mechanical wear on the old hardwood ties in contradis-

tion to the decay of the wood is demonstrated by the fact that while the base of the rail and the driven spikes have cut into the hardwood and weathered it, the material in the balance is as good as ever. The same experience has, of course, long been encountered and commented upon in the tie records of the United States. The difference between the experience there and here, however, lies in the fact that the ties referred to in the former records have probably not been used for a period longer than eight to 10 years, while local hardwood ties are from 20 to 25 years old, and have been used in a tropical climate where all other wood decays in from three to five years.

The black guayacum cross-tie is probably a thing of the past. Such material is now so valuable for other purposes in connection with machinery and manufacturing arts, that it is not to be expected that it can be procured at reasonable prices for cross-ties. The Panama Railroad Company has procured only 4,000 or 5,000 guayacum cross-ties in the past six years, and most of these have been of the inferior variety known as yellow guayacum.

During the past few years guayacum cross-ties have been purchased under the following prices and specifications:

Prices.

1898-1904.

First-class—6 by 8 inches, by 8 feet, \$1.50 each.

Second-class—5½ by 6 inches, by 7.9 feet, \$1 each.

1907.

First-class—6 by 8 inches, by 8 feet, \$1.62 each.

Second-class—5½ by 7 inches, by 7.9 feet, \$1.42 each.

1908-1910.

First-class—7 by 9 inches, by 8.6 feet, \$2.10 each.

Second-class—6½ by 8 inches, by 8.3 feet, \$1.75 each.

1911.

Second-class—6½ by 8 inches, by 8.3 feet, \$1.75 each.

First-class—7 by 9 inches, by 8.6 feet, \$2.25 each.

Specifications.

1. The material used shall be black or yellow guayacum, commonly known as guayaacan or *lignum vitæ*.

2. All ties shall be well and smoothly hewed out of straight growing timber of specified dimensions, and out of wind, sawed, or square cut ends, with straight and parallel sides and faces. All ties shall have bark entirely removed when cut. Ties shall be free of splits, loose, or decayed knots, or any other imperfections, which may impair their strength or durability. Not more than one inch of sap wood will be allowed, measured across the side or face.

3. Sawed ties will be accepted agreeing in other respects with the above paragraph, provided the saw cut extends throughout the length of the tie, making parallel sides and faces.

4. The width of the face and the thickness of the tie shall conform to sizes mentioned in the table of dimensions below, but a variation of size will be permitted to one inch over in thickness, one inch in width, and three inches over in length. No variation in size under those specified will be allowed:

Table of Dimensions.

	Thick- ness.	Width of face	Length	Maxi. variation from straight edge.	Top and Sides bottom
First-class	7"	9"	8'6"	½"	2"
Second-class	6½"	8"	8'3"	1"	3"

Not more than 10 per cent of any particular shipment will be accepted as seconds, and it is desired to reduce this percentage as much as possible.—*Canal Record*.

FILLER

Contraction and Expansion of Cement and Concrete—Abstract from paper by Dr. P. Rohland in "Mitteilungen der Centralstelle."

Concrete and reinforced concrete setting in air contracts, if they set in water or damp air, expansion takes place. Mixing more sand or else adding hygroscopic salts decreases con-

traction. Excessive contraction can be avoided by covering concrete with wet cloths.

When cement is mixed with water, a separation of elements in the colloidal state takes place. These elements absorb water, thereby increasing in volume, which is accompanied by a slight lowering in temperature. When setting begins, the volume gradually decreases and the temperature increases. The sudden coagulation of the colloidal elements in the cement which occurs with the separation of water is the cause of this decrease in volume and increase in temperature. The increase of volume during mixing is greater than the decrease while setting. A considerable decrease of volume takes place at the end of the setting process, for which allowances must be made if the concrete sets in air.

REGULAR SECTION GANGS AND EXTRA GANGS.

By O. A. McCombs, Roadmaster.

For maintenance of way work there should be both regular section gangs and extra gangs. The section gangs should be small and of regular size all year. Extra gangs should be used as needed, and the number of men in the gangs should be determined by the kind of work, and the amount of work to be done. A foreman can handle to advantage a great many more men on some jobs than he can on others.

The regular section gang should be just large enough to do the necessary work to keep track in good shape, and safe for service. A small gang going out to work could stop and change off a broken pair of angle bars, raise a low joint, put in a bolt or two, or tighten a joint, just as quick as a large gang could. With a small gang, a foreman does not object to stopping and repairing these places. But with a large gang, he would frequently hurry on to his regular work and let these small jobs go until some other time, rather than stop and have ten or twelve men watch one man tighten a joint. It is a bad practice for a foreman to have to put off necessary work, even small jobs. A regular section gang should, in the regular course of its work, always have time to stop at once and repair anything that the foreman sees needs repairing. Any small job that needs to be done should be done immediately and not put off until some other time.

A foreman should inspect his track frequently and know that it is safe. A small gang can run over the section quicker than a large gang and at less expense. There are a great number of small jobs of section work that a small gang can do just as quickly as a large gang, and if there are more than a few men, part of them are in the way.

One disadvantage of a large section gang is that much of the work would have to be looked after by one of the laborers, or a straw boss. A section foreman can only be in one place at a time, and while he is superintending the main work, he will have to send a "straw" to look after the small jobs.

There is a great deal of work done by sending a good man out with a couple of laborers to do the work, and it works all right some times. But it frequently happens that it is very much desired to know just who is responsible for a certain piece of work; and then it develops there was no foreman present, and the work was done by laborers and no one is individually responsible. The "straw" denies responsibility, saying he was not paid to run a gang, and that he was only working on the section.

Occasionally a handcar is broken by being struck by a train and there is also the danger of wrecking the train with the handcar, and sometimes in an investigation of an accident, it is brought out that there was no one with the car that was individually responsible. There were a number of laborers with the car, each having as much authority as the other, and while discussing when and where to put the car off, a train strikes it. The only responsible party was the foreman, because he let them have the car, and probably was miles away at the time of the accident.

There should always be a foreman with every gang, large

or small, working on the track. In small gangs the foreman could work as the other men do, but there should be always in the gang some one with recognized authority, competent to do the work and responsible for it. And this duty should not be relegated to any of the men when it can possibly be avoided.

A section gang should not be taken off of its own section to do regular work on a neighboring section, except in cases of emergency. If a foreman is putting forth his best efforts to keep his section in as good or better condition than his neighbor's and is then sent to do regular work on his neighbor's section, it puts a damper on his enthusiasm.

If a man's section was on bad material or for some other reason he could not do the regular section work required of him, it would be better to allow him more men, rather than to have the neighboring section gang help him out. Of course, if there is a job of work to do that is too heavy for one section gang, and it can be done in a day or two by concentrating a few section gangs, it is right and proper to do the work with the section men. It is more economical to do a small job with section men than to move an extra gang to do it.

All large jobs of work where a large number of men can be worked to advantage should be done by extra gangs. The extra gang should do all of the general overhauling and renewing in maintenance, the size of the gang to be regulated to the kind and the amount of work to be done. A man can work a great many more men to advantage on some jobs than on others.

Extra gangs can do the work cheaper and more satisfactorily than regular section gangs on account of being better able to put in all of their time on the work. A regular section gang must of necessity look after and do all of the necessary small repairs on the section, and it is frequently being called away to these small jobs. Work seems to get along very slowly when a gang is continually being called away to do something else, even with a large gang of men.

Extra gangs with good, competent foremen do good work. One fault I have noticed on some roads in the management of extra gangs is that they move the gang away from a job before it is completed, leaving the work for the section men to finish. The extra gang desiring to make a good showing in reports rushes ahead and leaves a little here and a little there for the section gang to finish. This is bad practice, and extra gangs should be required to finish all the work they were to do on a job before leaving it.

An extra gang of seventy-five men that has been reballasting and putting in ties might be moved off a job they could finish in two days, leaving a lot of old ties to pile and dispose of, a little lining to do, some low spots to raise, a lot of ballast to trim and dress up in proper shape, some embankment to strengthen and a ditch to clean. It would take the extra gang of seventy-five men two days to do the work, while one man would require one hundred and fifty days, and five men would require thirty days. Now if the section gang had just the proper allowance of men to do the regular repair work on the section, it would be several months before they found the time they could spare from the regular work to finish the job. And in the meantime this piece of track remains very unsightly. It would be much better to let the extra gang complete each job before leaving it.

As a rule you can procure extra gang foremen from among the section foremen. There are always men among the section foremen who are capable of handling extra gangs, who can be promoted when needed. Not all section foremen would make good extra gang foremen, but by selecting the capable ones you get a good class of foremen. Then to fill the place of the section foreman promoted, promote the most capable laborer to the position of section foreman. I mean by the most capable laborer, the one who it is judged would make the best section foreman.

Correspondence.

EXTRA GANG FOREMAN MORE CAPABLE THAN SECTION FOREMAN.

Editor *Railway Engineering*:

In regard to section foremen doing finishing work behind extra gangs, I do not agree with a great many roadmasters and foremen. I do not think that section foremen would leave as good a job as good extra gang foremen. How long would it take a section foreman with ten or twelve men to surface a finish raise on rock ballast on seven miles of track? I am afraid the track would be open a long time, for the best he could possibly do would be about thirty feet per man per day and the chances are he would not do that, where he had any number of trains to contend with, for he would be making runoffs all the time. And in trying to make a showing for a day's work, he would be hurrying his men and we all know what that means, with tamping picks. If you want good tamping you cannot hurry a man.

There are just about one-third of the section foremen we have today that can surface and line a rail out of face; they have learned to line small kinks, but when it comes to lining out a swing there are very few foremen that can get good line.

Also, as a usual thing where new ballast work is going on, they have had dirt track or cinders and the section foremen have never seen rock track put up, and we all know there is a lot of difference in raising and tamping. I have read where one roadmaster says it is impossible to get all the men to tamp the same so that track goes down in the panel where the poor tampers were, and stays up where the good tampers were, making a very uneven track. He is right, in one way, all men will not tamp the same but you can make all men do good tamping. But at that, some will tamp a tie a great deal more than the others but I think there is a way around that. I never allow one man to finish a tie. I start one gang tamping behind the jacks, just tamping the running side, and then I start a gang behind these tamping the other side on ends, then when I go to the centers I do the same way. That makes four men that tamp one-half of the tie or eight different men tamping on the same tie and I find by doing this that my track stays even and I do not get the small holes that you cannot avoid if each man tamps a certain number of ties.

I think that the roadmaster and the superintendent are to blame a great many times for poor work done by extra gangs. They put a man out with a large gang and they seem to think he should do it all in a few days and as a usual thing they get one extra gang man in one of their gangs that will do a galvanizing job, and get over a lot of track in a day and then they come out to the others and say, "Well, so and so is making so many feet to the man, why can't you do it?" They do not examine this fast man's work or yours. It all looks just about the same from the back end of a Pullman coach; and they will keep at the man that is doing good work until he has to do a poor class of work to make the speed that the other man does. I do not believe there are many foremen but would rather do good work than poor work. Of course there are some that think it an honor to do more than any other foreman and will do so at the risk of good work. A great many times you will find this kind of man an "old head" on the division, and roadmaster and superintendent do not watch his work very closely. I have seen foremen skeletonizing and putting in new ties where they jack track to loosen dirt, and as a consequence, leave dirt so high in center as to break the new ties they have just put in.

Where the engineers have set stakes to dig down three or four inches to get the correct amount of ballast under, some foremen will run over this and not dig it out at all but just put that much less ballast under. That gives such a man a long start over the man that is digging his track right so as to leave an even surface for ties and the same amount of ballast

under track. There are a thousand ways of doing work so as to make speed, but there is only one way of doing good work and that is do it right, and that is the cheapest work a railroad can get. If roadmasters and superintendents will tell their extra gang foremen to produce quality and not quantity, and then go out among their extra gangs and examine the work different foremen are doing, they can soon find out who is doing work that will stand and who is doing work that will have to be gone over again. I don't think there is much difference in the amount of work different foremen will do if they all do the same class of work, that is, considering they are all good foremen.

I think the greatest and hardest thing for any foreman to do is to learn how to handle his men, and that is where the average section foreman falls down. A great many extra gang foremen know how to do the work but they cannot get it out of the men. The old way will not work any more. You cannot swear and abuse men and get good work out of them. A foreman has got to figure them out. Every man has a place. I always try to learn my men and get them placed where they work best, also get them where they have to show up as much work as the others or it will show up on them. In this way you also know just who did the work in each spot. When you find a faulty piece of work you know just which man did it. I always bring the man back and make him do the work over and show him where he was to blame. Sometimes a foreman has to get after a man pretty strong for that, and then again you have a man that making fun of will do far more good than abusing. I find the average man hates to be ridiculed in front of a gang, and a smile and a little ridicule will, a great many times, make a good man for you. The other men will laugh at him if you do and he will try his best to show up some other man's work so he can have the laugh on him. Of course there are some men that are too lazy or think they are too smart and I discharge them at once, for it will show the other men that they will not be permitted to act so. I think a foreman should study this matter very closely and get acquainted with his men to get good results. I think that swearing and abusing men will ruin any gang and do not believe in getting too familiar with men. Let every man look just alike from seven a. m. till six p. m. to a foreman and have a smile once in awhile, also a stern look where it is necessary, let them know that you are foreman and want a day's work and good work and at the same time let them know when they do it you appreciate it and are a friend to them.

I find it very poor policy for a foreman to associate with his gang in their cars at night. At the same time, don't be too distant if one of them wants a favor. If one is sick, look after him, see that he gets medicine; if he wants you to write a letter for him or advise him in business matters let him know that you are honest with him and also with the company you are working for, and you will keep good men and they will do good work.

Now, I think the railroad companies need more foremen that are real men. We have a great many more now than we used to have, but we haven't enough yet. We have drunkards and gamblers and dead beats on nearly all divisions. Now these men are a detriment to the company, also a detriment to other foremen. And they should be discharged as fast as they are found. Sometimes they will do good work for a short time but in the end the company is the loser, for the man that is not honest to himself cannot be honest to the man he is working for. He also loses the respect of the men working under him and the people in the town where he resides, and this is against the interest of the company.

To get rid of such men would be a great help to our safety first movement. A good steady foreman that doesn't drink will watch his gang closely, thereby avoiding a great many accidents. Find a good foreman and you find a good gang. The steady man will get a steady gang and keep it. I once heard a roadmaster say "I have a lot of foremen that can work three

or four men but I have very few that can take a large gang." Section foremen and extra gang foremen are very different. Some of the best section foremen could not take a large gang and get it started to work, or start in on a job where track had to be all torn up, such as moving it or relaying, keeping traffic going. Of course, there are section foremen that make good extra gang foremen, but they are not always the best section foremen. Some men by nature can handle men, while others never can learn. I have been running section and extra gangs for thirteen years and have worked in a great many different places at different kinds of track work, also have taken a track course with an educational bureau and read every kind of a paper or book that I can get on track work; yet very often I find a job that I have got to learn to do. I do not think the average foreman, or for that matter, officials, even think of what a man has got to learn to be a good foreman. He can learn every day if he will try some new thing, and it will help him, and, of course, the more it helps him the more it helps the company he is working for.

Now, I do not see why a man who has had the experience that most extra gang foremen have had, cannot go out and do a better class of finished work than the average section foreman who has probably worked on his particular section for a year or so, and has been a foreman but a few months or a few years, probably on cinder or dirt track. If he can do a better class of finishing work with a saving for the company, as a great many are advocating, the newest section hand could be made foreman and the experience and years of hard work that most extra gang foremen have had would count for nothing.

If roadmasters and superintendents will give their foremen to understand that they want a good class of work, that will last, and at the same time want a reasonable amount done they will get good work and in the long run it will be cheaper for the company.

G. D. Kennedy, Extra Gang Foreman.

WORK WHICH NECESSITATES EXTRA GANGS.

E. O. Gillies, Roadmaster.

All section gangs should have enough men to enable them to handle all the regular maintenance work on their sections, as the regular section foreman is acquainted with and knows the existing conditions. Section gangs may be consolidated when the work to be handled on one section is sufficient to warrant it and by throwing the different gangs together, foremen can see how other foremen handle the various kinds of work.

The extra gangs should be used only where new work is being done that would be too heavy or require too many men for the regular section gang to handle. Ballasting and relaying of a large amount of rail should be done by extra gangs, with a foreman in charge who is experienced in the work. Work done by extra gangs should be done in a thorough manner so as to stand up well, but numerous foremen who are running gangs will slight their work in order to make a showing or record. The quantity of the work should not be sacrificed to quality, as a track well put up will be more economical in the long run than a track that is slighted—even though it does cost more to put the work up in the proper shape.

Considerable difficulty is experienced in the keeping of extra gang laborers as the wages paid are hardly sufficient to keep a man and the outfit cars furnished are usually in poor shape for bad weather. The foreign laborers are easier to retain for the reason that they do not spend so much money to live on and are satisfied with the lower rate of pay.

Our extra gang foremen are obtained from the regular section foremen—taking a section foreman and putting him in as extra gang foreman and having him put his best section laborer in charge of the section while the regular foreman is on the floating gang. We do not experience much difficulty in securing foremen for extra gangs as there are always two or three good foremen to pick from. I do not favor the em-

ploying of foreign foremen for gangs as they will favor their laborers more if they have men of their own nationality, while a native foreman will be more liable to treat his men all alike and not show any partiality.

I am of the opinion that section gangs should not be increased to do reballasting or any work of that nature as it will eventually demoralize the force and give a road a bad name account of the necessity of continually hiring and laying off laborers. A regular section force of sufficient men to handle the maintenance work on the section should be employed and retained on the section permanently.

Work, of course, that is done by extra gangs will cost more than it would were it done by the section force for the reason that the extra gang laborers are paid a higher rate than the section men, and usually the foremen are paid from \$15.00 to \$20.00 more per month than a regular section foreman.

CLINCH NUT LOCK

A new locking nut for track bolts designed to grip the bolt so that the nut will not come off has recently been evolved, called the clinch nut. In appearance, this resembles an ordinary track nut and it has no cotter, keys or other attachments. The locking part is on the face of the nut as shown on the photograph herewith.

The nut starts with the fingers and requires no special tools



Clinch Nut for Track Bolts.

—a common track wrench being all that is necessary to apply it. The grip of the fastening device is absolutely permanent, it is claimed, and will resist vibration no matter how severe.

The nut lock described and illustrated herewith is being manufactured by the Clinch Nut Co., 1709 Austin Ave., Chicago, Ill.

WATERPROOF CONCRETE.

Tests being made at the College of Engineering, University of Wisconsin, Madison, Wis., have demonstrated some simple means of waterproofing concrete.

The test specimens are cylinders 13½ inches in diameter, so arranged as to expose the faces to predetermined water pressures and to enable the thickness of concrete through which the water must pass, to be varied from 4 to 18 inches.

For 1:1½:3 mixtures of cement, Janesville torpedo sand and Janesville gravel, mixed to a wet consistency, the test specimens have been found impervious to 40 lbs. per sq. inch water pressure.

If dry sand and gravel are used a mixing of two to three minutes in the mixer gives good results. When the materials are wet before they are put in the mixer a considerable longer time is required to obtain good results. This indicates that if impervious concrete is desired, wet materials should not be used.

Graded gravel mixtures as lean as 1:6 have proven impervious at high pressures, when care has been exercised in proportioning the amount of water in mixing the concrete.

Personals

Operating

J. M. DAVIS has been appointed general manager of the *Baltimore & Ohio South Western R. R.* at Cincinnati, O. He entered railway service as freight brakeman, and was stenographer on the Santa Fe for three years. He was with the Great Northern Ry. for eight years as chief clerk, assistant superintendent, superintendent and assistant general superintendent. He was then employed for three and one-half years with the Erie R. R. as superintendent, and for seven years with the Southern and Union Pacific Rys. as general superintendent. He entered the service of the B. & O. S. W. R. R. January of this year as assistant general manager, and was promoted to general manager March 1.

L. H. PHETTEPLACE, formerly general superintendent, has been appointed general manager of the *Carolina, Clinchfield & Ohio Ry.*, office at Erwin, Tenn.

F. CONE, formerly assistant superintendent, has been appointed



J. M. DAVIS, General Manager
Baltimore & Ohio South Western R. R.

superintendent of the *Chicago, Burlington & Quincy R. R.* at Beardstown, Ill. He succeeds W. F. THIEHOFF, appointed superintendent at La Crosse, Wis., succeeding D. Cunningham.

J. A. GORDON, formerly general superintendent of the Pere Marquette R.R., has been appointed general manager of the *Chicago Great Western R. R.*, office at Chicago.

J. J. MURPHY, formerly trainmaster, has been promoted to superintendent of the *Chicago, Milwaukee & St. Paul Ry.* at Three Forks, Mont., succeeding W. H. Molchoir.

H. E. CORRELL, formerly trainmaster, has been promoted to superintendent of the *Chicago, Rock Island & Pacific Ry.* at Eldon, Mo. He succeeds H. L. REED, appointed superintendent at Fairbury, Neb., succeeding A. W. Kelso.

G. W. HOWE has been appointed superintendent of the *Clarendon & Pittsford R. R.*, office at Proctor, Vt., succeeding T. E. Moore.

J. H. O'NEILL, formerly assistant general superintendent of the *Great Northern Ry.*, has been promoted to general superintendent at Seattle, Wash., succeeding J. Russell, resigned to accept service with another company. L. W. BOWEN, formerly superintendent, has been promoted to assistant general superintendent at St. Paul, Minn. He succeeds E. LEVERICH, appointed assistant superintendent at Spokane, Wash., vice Mr. O'Neill. W. CAESWELL, formerly trainmaster, has been promoted to superintendent of the Marcus division, office at Marcus, Wash. He suc-

ceeds J. M. DOYLE, appointed superintendent of the Montana division, office at Havre, Mont., vice G. S. Stewart, promoted. P. F. KEATING has been appointed superintendent at Breckinridge, Minn., succeeding G. E. Votaw, transferred. J. E. LINDSAY has been appointed superintendent at Melrose, Minn. He succeeds W. D. MASON, formerly trainmaster and acting superintendent, now promoted to superintendent at Sioux City, Ia., vice Mr. Keating. GEO. S. STEWART, formerly at Havre, Mont., has been appointed superintendent at Spokane, Wash., succeeding L. W. Bowen, promoted. G. E. VOTAW, formerly at Sioux City, Ia., has been appointed superintendent at Superior, Wis., succeeding S. Ennes.

J. K. JONES, formerly trainmaster, has been promoted to superintendent of the *International & Great Northern Ry.* at San Antonio, Tex.

H. A. BUTLER has been appointed president and general manager of the *Mauch Chunk Switch-Back Ry.*, office at Mauch Chunk, Pa., succeeding A. P. Blakslee.

W. E. GREEN has been appointed general superintendent of the *Midland Valley R. R.* at Muskogee, Okla.

E. J. PARRISH, formerly superintendent at Ft. Wayne, Ind., has been appointed superintendent of the *New York, Chicago & St. Louis R. R.* at Buffalo, N. Y. He succeeds W. F. WATTERSON, appointed superintendent at Ft. Wayne, Ind.

C. S. KRICK, formerly superintendent at New York, has been appointed superintendent of the *Pennsylvania R. R.* at West Philadelphia, Pa., succeeding J. B. Baker. R. V. MASSEY has been appointed superintendent at New York, succeeding Mr. Krick.

F. L. BURCKHALTER, formerly division engineer, has been appointed superintendent of the *Southern Pacific Co.* at Portland, Ore.

S. ENNES has been appointed general superintendent of the *Western Maryland Ry.*, office at Baltimore, Md.

Engineering

F. VON SPRECHEN, formerly transitman, has been appointed assistant engineer of the *Atlantic Coast Line R. R.* at Savannah, Ga., succeeding C. J. Cheworth, promoted.

G. F. EBERLY has been appointed division engineer of the *Baltimore & Ohio R. R.* at Wheeling, W. Va. He succeeds H. H. HARSH, promoted to division engineer at Cleveland, O., succeeding F. J. BACHELDER.

F. C. SHEPHERD, formerly engineer of construction, has been appointed valuation engineer of the *Boston & Albany R. R.*, office at Boston, Mass. GEO. L. HUCKINS, division engineer of construction, has been transferred from Lynn to Boston, Mass.

L. C. FRITCH, formerly chief engineer of the *Chicago Great Western R. R.*, has been appointed chief engineer of the *Canadian Northern Ry.*, office at Winnipeg, Man.

T. LEES has been appointed assistant division engineer of the *Canadian Pacific Ry.*, Alberta division, at Calgary, Alta. E. B. SKEELS, resident engineer, has been transferred to Calgary, Alta.

C. G. DELO, formerly engineer maintenance of way, has been appointed chief engineer of the *Chicago Great Western R. R.*, office at Chicago. I. F. WHITE has been appointed engineer maintenance of way at Chicago, succeeding Mr. Delo.

G. DAVIS has been appointed division engineer of the *Chicago, Rock Island & Pacific Ry.* at El Reno, Ark. K. HANGER has been appointed division engineer at Eldorado, Ark.

J. C. LEEPER has been appointed chief engineer of the *De Queen & Eastern Ry.*, at De Queen, Ark., succeeding E. S. Byington.

D. J. BRUMLEY, formerly assistant chief engineer, has been appointed valuation engineer of the *Illinois Central R. R.*, office at Chicago, Ill. F. L. THOMPSON, formerly construction engineer, has been appointed assistant chief engineer to succeed Mr. Brumley, office at Chicago. Autobiographies of both Mr. Brumley and Mr. Thompson were published in the May, 1913, issue of this Journal. A. F. BLAESS, formerly district engineer, has been appointed engineer maintenance of way, office at Chicago. A. A. LOGUE has been appointed assistant engineer at Ft. Dodge, Ia., succeeding C. C. Haire.

J. C. RESCH, formerly division engineer of the Texas & Pacific Ry., has been appointed assistant chief engineer of the *International & Great Northern Ry.*, office at Houston, Tex.

J. H. ROACH, formerly assistant engineer of construction, has been appointed assistant valuation engineer of the *Lake Shore & Michigan Southern Ry.*, office at Cleveland, O. A. M. CURRIER has been appointed assistant engineer at Cleveland, O., succeeding Mr. Roach. P. D. HUBBARD has been appointed assistant engineer at Cleveland, O.

JOHN C. HOEHLE has been appointed architect of the *Louisville & Nashville R. R.*, office at Louisville, Ky., succeeding J. A. Galvin.

H. L. THOMAS, formerly supervisor, has been appointed division engineer of the *Northern Central Ry.* at Elmira, N. Y. He succeeds W. B. THOMPSON, appointed division engineer at Williamsport, Pa.

F. V. BERKEY has been appointed assistant engineer of the *Pennsylvania Lines West* at Zanesville, O. He succeeds J. A.

moted to principal assistant engineer of the *Southern Ry.* at Birmingham, Ala., succeeding E. M. Durham. F. T. MILLER has been appointed assistant engineer at Washington, D. C. W. B. WALLIS has also been appointed assistant engineer at Washington, D. C. E. L. MEADERS has been appointed junior engineer at St. Louis, Mo., succeeding F. T. Miller.

F. ADAMS, formerly general foreman of bridges and buildings, has been appointed division engineer of the *Texas & Pacific Ry.* at Alexandria, La. F. W. BETTLE, formerly assistant engineer, Terminal R. R. of St. Louis, has been appointed division engineer at New Orleans, La., succeeding T. M. Teed, transferred. R. E. CAUDLE, formerly assistant engineer, has been appointed division engineer at Big Spring, Tex., succeeding J. C. Resch, resigned. T. M. TEED, formerly at New Orleans, has been appointed division engineer at Dallas, Tex. S. D. BACON has been appointed assistant engineer at New Orleans, La.

J. C. LEEPER has been appointed chief engineer of the *Texas*,



L. C. FRITCH, Chief Engineer
Canadian Northern Ry.



C. G. DELO, Chief Engineer
Chicago Great Western Ry.

ROTHROCK, appointed assistant engineer at Louisville, Ky., vice J. L. Taylor, Jr., transferred. H. J. SHAW, formerly at New Castle, Pa., has been appointed assistant engineer at Chicago, Ill., succeeding W. E. Guignon, promoted. J. L. TAYLOR, JR., has been appointed assistant engineer at New Castle, Pa., succeeding Mr. Shaw.

CHARLES HANSEL has been appointed consulting valuation engineer of the *Philadelphia & Reading Ry.* at Philadelphia, Pa. CARL TOMBO has been appointed principal assistant valuation engineer, E. Y. ALLEN has been appointed assistant valuation engineer, and E. F. STERNER has been appointed civil engineer, valuation department, all with offices at Reading terminal, Philadelphia, Pa.

A. L. ADAMS, formerly engineer of construction, has been appointed superintendent of way and structures of the *Puget Sound Electric Ry.*, office at Tacoma, Wash.

GEO. H. BINKLEY has been appointed chief engineer of the *San Francisco-Oakland Terminal Rys.*, office at Oakland, Calif.

H. H. TEMPLE has been appointed superintendent of maintenance of way of the *San Antonio & Aransas Pass Ry.*, office at Yoakum, Tex.

D. M. McKEY has been appointed locating engineer of the *Seaboard Air Line Ry.* at Norfolk, Va., succeeding H. S. Thomas, promoted. L. A. MURR has been appointed assistant engineer at Portsmouth, Va., succeeding R. M. Coburn, transferred to the chief engineer's office.

H. C. SHILLINGS has been appointed chief engineer of the *South Manchester R. R.*, office at South Manchester, Conn.

FELDER FURLOW, formerly assistant engineer, has been pro-

moted to principal assistant engineer of the *Oklahoma & Eastern R. R.*, office at Broken Bow, Okla.

E. K. MENTZER, formerly assistant engineer, has been appointed supervisor of bridges and buildings of the *Boston & Albany R. R.* at Worcester, Mass.

S. BEATTIE has been appointed supervisor of bridges and buildings of the *Grand Trunk Ry.* at St. Henri, Que.

F. W. BARRINGTON has been appointed master carpenter of the *Great Northern Ry.* at Whitefish, Mont., succeeding E. Reinking.

Signaling

R. S. BENTLEY has been appointed signal supervisor of the *Chicago, Milwaukee & St. Paul Ry.* at Milwaukee Shops, Wis.

J. J. O'CONNOR has been appointed signal supervisor of the *Eric R. R.* at Salamanca, N. Y., succeeding S. B. Carling.

C. N. BECHNER, formerly signal supervisor, has been appointed assistant signal engineer of the *Louisville & Nashville R. R.*, succeeding R. H. White, resigned to become editor of *The Signal Engineer*. F. H. BAGBY, formerly signal inspector, has been appointed signal supervisor at Louisville, Ky., succeeding Mr. Bechner. W. F. HUDSON succeeds Mr. Bagby as signal inspector, office at Louisville, Ky.

W. E. BOLAND, formerly assistant signal engineer, has been appointed signal engineer of the *Southern Pacific Co.* at San Francisco, Calif.

C. W. HIXSON, formerly signal inspector on the *Pennsylvania Lines West*, has been appointed signal supervisor of the *Vandalia R. R.*, succeeding F. H. Buchanan, promoted to signal engineer.

Maintenance of Way

CHARLES JOHNSON has been appointed roadmaster of the *Atchison, Topeka & Santa Fe Ry.* at Williams, Ariz., succeeding T. A. Moore.

E. BYE has been appointed roadmaster of the *Canadian Pacific Ry.*, Alberta division, at Strathcona, Alta., succeeding J. Todd. J. H. GUTHRIE has been appointed roadmaster at Aroostook Jet., B. C., succeeding A. King. THOS. PETERSON has been appointed roadmaster at MacLeod, Alta.

J. B. AUSTIN, formerly roadmaster on the A. C. L. R. R., has been appointed supervisor of track of the *Central of Georgia Ry.* at Millen, Ga., succeeding F. A. Ross.

S. A. HOKE, roadmaster of the *Chicago, Burlington & Quincy R. R.*, has been transferred from Creston to Red Oak, Ia., following a rearrangement of territory. WM. PETERSON has been appointed roadmaster at Creston, Ia.

ALBERT ANDERSON, formerly yard foreman, has been promoted to roadmaster of the *Chicago, Milwaukee & St. Paul Ry.* at Sioux Falls, S. D., succeeding George Mee. THOS. MCGEE, formerly roadmaster at Malden, Wash., has been appointed roadmaster at Madison, S. D.

G. B. HARPER has been appointed supervisor of track of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.* at Mt. Carmel, Ill., succeeding J. H. Keenan.

HARRY NEW, formerly extra gang foreman, has been promoted to

roadmaster of the *El Paso & South Western Ry.*, at Duran, N. M., succeeding F. M. Davis.

W. FITZGIBBON, supervisor of track of the *Grand Trunk Ry.*, has been transferred from Kingston to Brockville, Ont. He succeeds M. J. HENDERSON, appointed supervisor of track at Ottawa, Ont. T. YERROW has been appointed acting supervisor of track at Kingston, Ont.

W. H. ROBERTS, roadmaster of the *Kansas City, Mexico & Orient Ry. of Texas*, has been transferred from Ft. Stockton to San Angelo, Tex., succeeding R. S. Baxter. W. S. TRIMBLE, formerly resident engineer, has been appointed roadmaster at Ft. Stockton, Tex., succeeding Mr. Roberts.

F. E. SMEAD has been appointed roadmaster of the *Lake Shore & Michigan Southern Ry.*, at Cleveland, O.

J. T. MARSHALL has been appointed supervisor of the *Louisville & Nashville R. R.*, at Richmond, Ky., succeeding Mr. Keller.

J. W. MCMANUS has been appointed acting roadmaster of the *Missouri Pacific Ry.*, at Omaha, Neb., succeeding E. V. Bell.

G. M. SKELLY has been appointed roadmaster of the *Northern Ry. of Costa Rica*, at Zent, C. R.

A. LEWIS has been appointed roadmaster of the *St. Louis & San Francisco R. R.*, at Oklahoma City, Okla., succeeding E. Abramson.

NELS JOHNSON has been appointed roadmaster of the *Tacoma Eastern R. R.*, at Tacoma, Wash., succeeding F. M. Webb.

THOS. HIGGINS has been appointed roadmaster of the *Texas & Pacific Ry.*, at Bonham, Tex.

With The Manufacturers

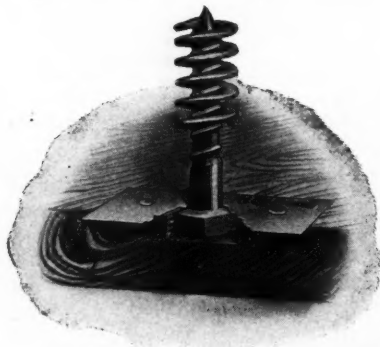
INSERTS FOR CONCRETE WORK.*

Inserts that can be used in the forms have become an important detail in concrete structures because a little consideration in locating inserts on the plan does away with an immense amount of costly drilling when the structure is completed. Some architects stud factory ceilings and side walls with inserts at the corners of squares, two or three feet on a side, over the entire area so that shafting and other fixtures may be readily

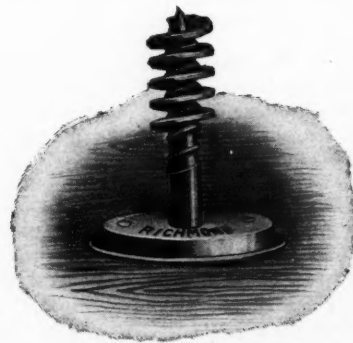
countersunk by using a clamp as large as the base of the fixture. Several bolts may also be accurately set as a unit, the clamp acting as a templet. The clamps are of thin metal and can readily be punched to order.

The small size of this insert makes it ideal for complex reinforcement, as it will readily fit between the reinforcing rods.

These inserts are made by the Richmond Screw Anchor Co., New York City.



Screw Anchor With Countersunk Head.



Screw Anchor With Head Flush With Surface.

attached at any time. These inserts are usually of cast iron and can be nailed to the forms; when the forms are removed the metal face of the insert shows at the surface of the concrete.

The illustrations show a steel spiral insert that has been on the market for some time, but the metal clamps for nailing the bolts to the forms are a new feature. The spiral anchorage can be located at any depth from the concrete surface, thereby giving any holding power up to the tensile strength of the bolt. The head of the bolt may be countersunk, as shown, or flush with the surface. The second method requires a shallow auger hole in the form; never more than $\frac{1}{8}$ " for an inch bolt, so that no injury is done to the forms. Entire fixtures may be

*From the Journal of the Engineers' Club of Baltimore.

TWIN RECEPTACLE, WITH HOUSING.

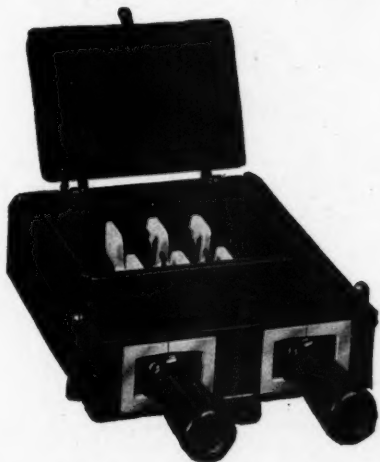
The constant demand from electrical engineers for a twin receptacle, with housing has resulted in the design by the Central Electric Co., of a Ralco twin receptacle, either fused or fuseless. The No. 15 Ralco consists of two 30 ampere receptacles fitted into a cast iron box 6"x8"x2 $\frac{1}{4}$ " deep. In the design of the box special attention was given to the ease with which it could be wired, and to assist the electrician ample space was provided for that purpose. The box is primarily designed for inside use, and is fitted with $\frac{3}{4}$ " knockout on two sides and top. If the receptacle is required for outside use, it can be made waterproof.

The No. 16 is identical in construction to the No. 15, except that the box is 9 $\frac{1}{4}$ "x8"x2 $\frac{1}{4}$ " deep, with space on top for either

one or two No. 91102 D & W Cutouts. When equipped with one cutout the boxes are marked 15 amperes per plug; when equipped with two cutouts, 30 amperes per plug, because the fuse block governs the rating.

Fuse blocks and receptacles are wired, so that all that is necessary in order to install it, is to bring the line wires down to the terminals of the fuse block. A door is provided in front in order to make it easy to remove a fuse when blown.

The No. 15 and 16 Raleco are especially desirable around



Twin Receptacle With Housing.

machine shops where two portable light outlets or portable motor outlets are required. The saving in time in mounting the receptacles, as compared with the single units, where two outlets are required, is very marked.

FAIRMONT MOTOR CAR ENGINES.

In the October, 1912, issue of *Railway Engineering* there appeared an article descriptive of the gasoline engines manufactured by the Fairmont Machine Co., Fairmont, Minn., for application to hand cars and to light inspection cars. Since the appearance of this article the Fairmont motor cars have been placed in service in large numbers on nearly all of the railway systems of the country, where the use of power section, inspection or other gang cars is encouraged.

Although the fuel item in the operation of these small engines is not an important one, there has been a movement to encourage the use of kerosene on account of the fact that this fuel is more readily obtainable at points along the line where it must be kept for other purposes. To supply this demand the Fairmont engine has been adapted to burn the cheaper fuel, where it is preferred. That it does so successfully was demonstrated at the company's exhibit during the American Railway Engineering Association convention in Chicago, March 17-20. In the exhibit a Fairmont engine was running continuously on kerosene during the four days of the convention.

The engine is a high development of the two-cycle principle, and the degree of simplicity attained is remarkable. In its application to hand cars this simplicity is also carried out in the method of transmitting the power. The sliding base allows of a simple method of handling the power by tightening or loosening the tension on a leather belt which serves as the transmission to the axle through a pulley. This pulley is quickly clamped in place on any hand car and the complete change from hand to motor power is made in a period of two hours. Two pulleys for the engine are furnished for the purpose of allowing a change in the proportionate engine and car speeds when it is wished to change the loading or to haul a trailer. The smaller pulley is used in ordinary hand car work

and the substitution of the larger pulley can be made in two minutes.

The Fairmont engine itself is the best reason for the success of the outfit. Its unusually light weight and great power place it beyond criticism. Built like an automobile engine, with metal only where it is needed—the engine bearings are twice the usual length. Its perfect balance and smooth running quality make it possible to leave a great deal of useless weight out of the base, required by some four-cycle engines.

The remarkable power is due to its being two-cycle. Pulling a load, it explodes every turn of the flywheels, or twice as often as the four-cycle, which explodes every other turn.

However, an ordinary two-cycle motor is not satisfactory for hand car work. Its throttle governor is all right for marine service in launches, etc., where there is always a full load to pull. A hand car engine does not work under full load all the time. In running through towns, approaching bad crossings, rounding curves, inspecting track, etc., most men want their car to run slower.

With a common two-cycle, the only way to do this is either to shut it off entirely and coast, or throttle it down, reducing the amount of gasoline or air, or both, in each charge. This is very wasteful of gasoline, as slight power is developed from the faulty charges, which are taken every turn of the flywheels, whether exploded or not.

The Fairmont two-cycle engine is slowed down by throwing out the speed lever, which allows the "hit and miss" governor to control the speed. This governor gives the engine fuel and sparks for only one revolution in several, and the speed can be made very slow by setting the governor.

Another advantage of this type of outfit is the facility with which it is run in either direction. The car need never be turned, as it runs equally well in either direction.

Lubrication is taken care of by mixing oil with the gasoline fuel. This is made possible by the fact that, in the two-cycle type, the fuel is taken through the crank case, rendering oil cups unnecessary. The air-tight crank case also prevents any collection of dust and grit, which would be most harmful to moving parts.

These engines are water cooled and there has been no complaint of trouble in the coldest winters, while the engine is properly cooled in the warmest weather.



ROBERT R. STANLEY, Cons. Engr.
Fire Protection and Prevention.

FIRE PREVENTION AND PROTECTION.

To a public service corporation a fire often results most disastrously, not only on account of the attendant financial loss, but



Combination Spring and Mechanical Nut Lock.



I. C. R. R. Crossing at 16th St., Where Hunt Nut Locks Were Installed.

TEST OF HUNT NUT LOCKS.

One of the recent inventions which is demanding the attention of railroad officials throughout the country and seems destined to attract marked attention in the nut lock industry is the Hunt Cross Thread Nut Lock.

The accompanying illustration shows this device in service on one of the most important and busiest crossings of the Illinois Central R. R., over which it is estimated that 1,000 trains pass during the twenty-four hours of the day. On this crossing every known device for locking nuts on the frog bolts has been tried without success, until the application of the Hunt Cross Thread Nut Lock was made on two of the frogs of this crossing about two weeks ago, since which time they have caused the nuts to remain absolutely tight. These nut locks have not been touched since application while with the other devices at this location, it is necessary to keep tightening them every few minutes—one man spending his entire time performing this duty.

The novel feature of the Hunt nut lock, in addition to its being a one-thread cross thread proposition, is its construction, which makes it positively immune to all vibration. After eighteen months of service tests, both on track and rolling stock, this device has been adopted as standard on three of the large railway systems and in view of its efficiency and economy it is destined to occupy an important place as a nut locking device on American railways. The Hunt nut lock is guaranteed for the life of the bolt by Hubbard & Co., Pittsburgh, sole manufacturers.

THE UNIVERSAL SAW.

A saw which will take care of a large number of varying conditions is being manufactured and has been placed on the market recently.

This saw will cut any angle desired and is useful in cutting around places where the space is very limited and where accurate work is necessary.

The saw blade may be adjusted into any position—at an angle to a horizontal plane, and at an angle to a vertical plane, so that a board laid lengthwise of the machine may be cut at angles across its width and thickness at the same time.

The saw mandrel and stock supporting table can be shifted for adjustment of parts simultaneously. Novel means are provided for a table and saw mandrel, so that they may be adjusted independently. A combination is also provided whereby a reciprocating saw blade may be improvised on this device, and these features make it possible to perform a great many operations on the machine.

The Universal Saw is being manufactured by the Casey Universal Saw Co., Merchants Bldg., Cincinnati, Ohio.

TIMBERS PRESERVED IN SALT LAKE.

In replacing a railroad trestle recently burned, along the north shore of Great Salt Lake, engineers have just found that the piles are still perfectly sound after forty-three years of service, having been impregnated throughout with salt from the lake and thus preserved.

RECORD SERVICE OF OKONITE CABLE.

The Okonite Company has recently taken up a cable laid by them in 1900 and 1904, in underground conduits to connect with the Trans-Atlantic and other deep sea cables of the Commercial Cable Company, the route being from their main office in New York City to a point on the sea shore of the eastern end of Coney Island.

The United States government decided to dredge a channel into Jamaica Bay, and the cables of the Commercial Cable Co. crossing the line of their proposed operations, the cable company was notified by the government to remove its cables, and it met the issue by transferring its landing place from Coney Island to Far Rockaway, which is well outside of the zone of dredging operations.

This necessitated the laying of an underground connection from the main office in New York City to Far Rockaway, a distance of twenty-two miles, and the contract for the making of this connection was awarded to the Okonite Co. and consisted of three 14-conductor lead covered cables installed in underground conduits which, when the installation was complete, tested up to the usual Okonite standard and well in excess of the specifications, which were most exacting.

The transfer of the ocean cables and the connection with the office having been accomplished there was no further use for the cables over the Coney Island route, so it was decided to take them out of the conduits and relay them as extra con-

ductors over the Far Rockaway line. This work is now in progress and as the sections are relaid and connected up, tests show the electrical and physical condition of the conductors to be practically unimpaired after fourteen and ten years of uninterrupted service.

The Commercial Cable Co. states that all of the cables which have been withdrawn (about eighteen miles in length) have proved to be in excellent condition, so much so that they are relaying them between New York and Far Rockaway, and judging from their condition, have every reason to hope that they will still last many years, as from their appearance the time elapsed since they were laid does not seem to have affected the insulation at all.

REOPENING OF THE SOUTHERN HOTEL.

The Southern Hotel at St. Louis, which was one of the best known and most popular with railroad men, is to be reopened on May first on a strictly modern and high-class basis and will be operated along the same lines which made it so popular in days past. The original Southern Hotel was built by Thomas Allen, but was destroyed by fire in 1877. Allen then determined to build a hotel which could not burn and in building the new hotel, steel rails and stone were used. This building was erected in 1880. Since that time many prominent men have been entertained under its roof. The St. Louis Railway Club held its meetings there for many years and there is now quite a favorable sentiment being shown towards holding its meetings there in the future.

The hotel has 3,500 guest rooms and is to be operated on the



JACK RYAN, Manager
Southern Hotel, St. Louis.

European plan exclusively. The Missouri Athletic Club has engaged quarters on the ground floor for two years and this of course will serve to add to the popularity of the hotel.

The new officers are: Walter Powell, president; Joseph Turley, secretary and treasurer, and "Jack" Ryan, manager. "Jack" Ryan will be well remembered by the former patrons of the hotel as he has been connected with it since 1888, with the exception of two or three years. Ryan is always there with ever present good cheer and hospitality and no one need be blue while he is on the job.

The reopening of this hotel will undoubtedly meet with great favor among supply and railway men as well as others.

The plans of the New York Central and the Pennsylvania for a new passenger station in Cleveland, Ohio, have been approved and will be submitted to a referendum election to be held in November.

Industrial Notes

THE GORDON PRIMARY BATTERY CO., exhibited at the Coliseum, Chicago, their New Type Gordon RSA Cell, an interesting feature in connection with which was the curve sheets showing the capacity of the battery under a discharge of 3 amperes. The 3 ampere curve sheet showed 134 hours, which is over 400 A. H., before the voltage dropped to .5 volt. This attracted considerable attention in view of the fact that the proposed new specifications for primary battery as appearing in the March issue of the Journal of the Railway Signal Association calls for 120 hours. The curve sheet at 1 ampere discharge showed 500 hours. Considerable interest was shown in these results as indicating the improvement and advance that has been made in primary battery manufacture. The track battery, also shown by this company, embodies unique features and attracted considerable attention.

Charles H. Locher has handled 6,235,000 cubic yards of material with Lidgerwood cableways while connected with various contracting firms as partner. This represents a mass three times as large as the concrete placed by Lidgerwood Cableways in the Gatun Locks at Panama, the largest mass of concrete in existence. The following comprises the operations in which Mr. Locher has used Lidgerwood Cableways, together with the amount of material handled in each case: Chicago Drainage Canal, 1,700,000 cu. yds.; West Neebish Channel, St. Mary's River, 1,700,000 cu. yds.; The Livingston Channel, 1,700,000 cu. yds.; Hydro-Electric Development, James River, 100,000 cu. yds.; Western Maryland Railroad, 35,000 cu. yds.; Wachusett Dam, 400,000 cu. yds.; N. Y. State Barge Canal, to date, 600,000 cu. yds. (cableway still at work).

SIDNEY G. JOHNSON, general sales manager of the Union Switch & Signal Company, has been elected vice president.

W. DOUGLAS WAUGH has been appointed general sales agent of the Kalamazoo Railway Supply Company, Kalamazoo, Mich. He was formerly with the Belle Isle Motor Co.

D. R. MORRIS has resigned as signal engineer of the El Paso & Southwestern and will go with the Federal Signal Co.

SIDNEY G. JOHNSON, general sales manager of the Union Switch & Signal Company, has been appointed vice-president in charge of sales and engineering of the company, with office at New York.

W. D. UPTGRAFF has been made vice-president of the Union Switch & Signal Co.

Brown-Williams-Bell-Hanson & Boettcher announce a dissolution of partnership by mutual agreement, to take effect April 1, 1914. Charles A. Brown, Harvey L. Hanson and Arthur H. Boettcher will continue in partnership in the practice of patent and trade mark law at 1550 Monadnock block. Lynn A. Williams will continue in practice in the same branches of the law with offices in the Monadnock block. Albert C. Bell will continue in practice in partnership with Henry M. Huxley with offices at 2001 208 South La Salle street.

THE BINTLIFF SUPPLY CO. has recently been incorporated and is occupying the store at 409 North Third street, St. Louis, Mo. This company is organized to manufacture a line of rail benders, track drills, track levels and track gauges, and also represent several large Eastern manufacturers, such as E. F. Houghton & Co., of Philadelphia; Lincoln-Williams Twist Drill Co., of Taunton, Mass.; Massachusetts Saw Works, of Springfield, Mass., and others. The officers of the company are C. T. Jones, president; H. B. Bintliff, vice president and treasurer, and J. F. Bartmen, secretary.

The Lehigh Valley will spend about \$3,000,000 in improving its terminal facilities at the Morris Canal, Jersey City, N. J., it is said. This road has purchased land in Buffalo, N. Y., as part of a site for a new station.

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